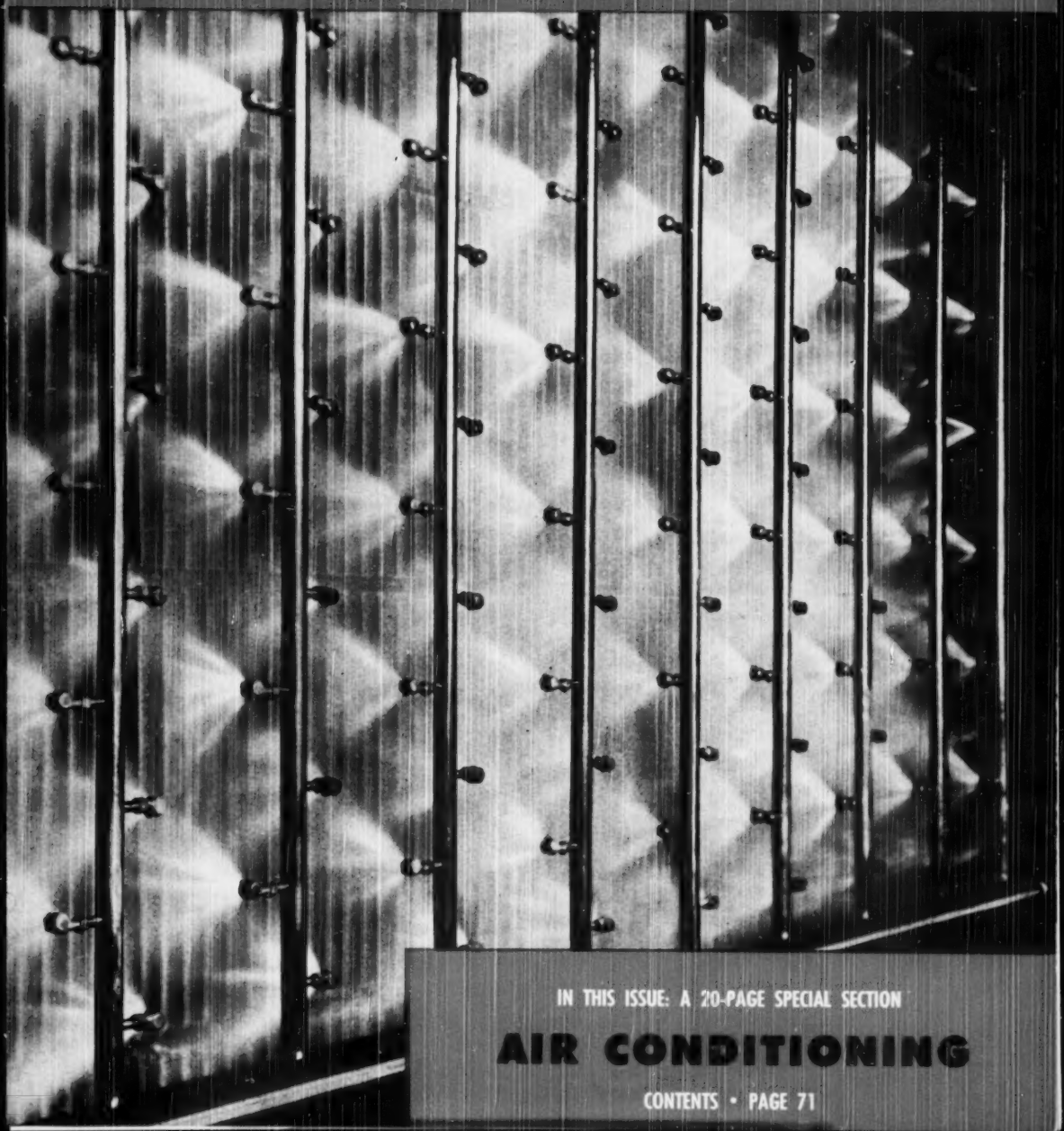
POWER

APRIL 1950

A McGRAW-HILL PUBLICATION DEVOTED TO GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES



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AIR CONDITIONING

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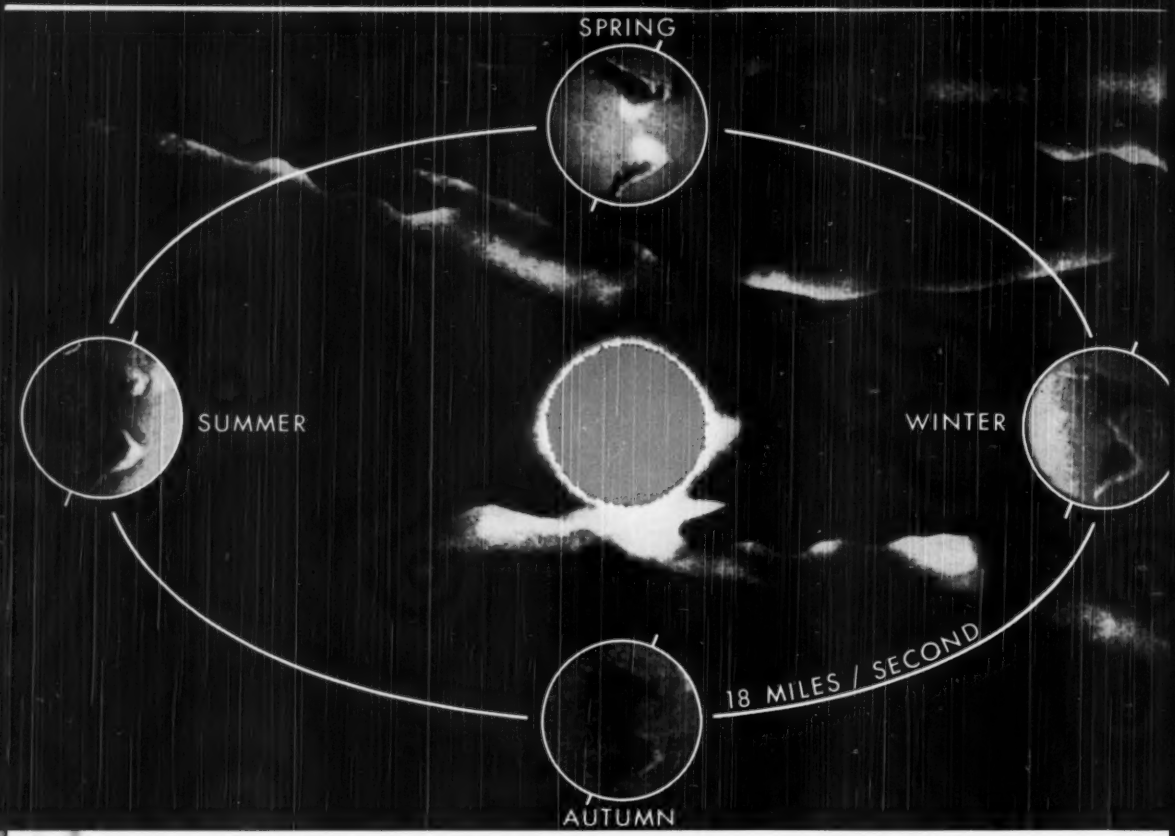


SEASONS ALWAYS RETURN, LIKE the WATER

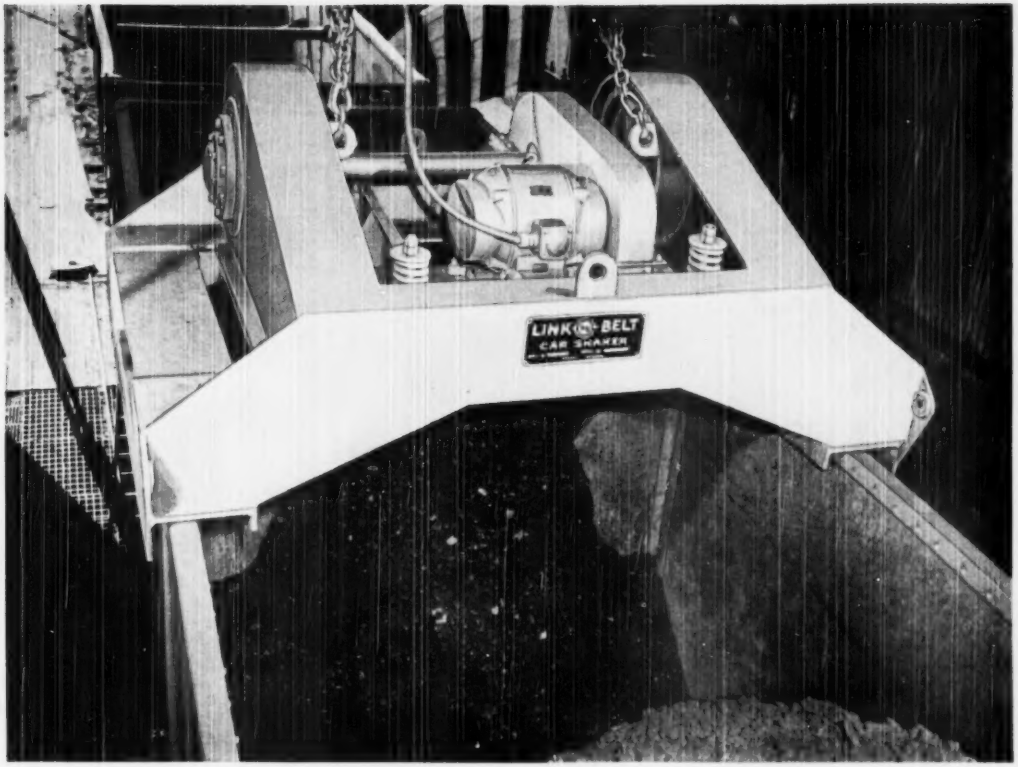
in modern ash and dust handling

Systematic rotation of the earth around the sun always bringing back the four seasons with predictable regularity is like recirculating water in modern Hydrojet and Hydrovac ash and dust handling systems. The amount of water used in either system can be accurately estimated, returned, and used over and over again, thus saving costs on unnecessary and excessive use of water and, at the same time, conserving water that, in many areas, is already scarce. Only a small amount of make-up is required to compensate for water absorbed by ash and dust. Furthermore, no water goes to sewer or waste, thus helping to prevent stream and harbor pollution. For systematic handling of ash and dust, you can't afford not to find out more about Recirculating Hydrojet and Hydrovac. Our nearest representative can explain how water in Hydrojet and Hydrovac returns as systematically as the seasons. Write us.

HYDROJET *and* HYDROVAC

ALLEN-SHERMAN-HOFF CO., 227 S. 15th ST., PHILADELPHIA 2, PA. *Offices & Representatives in Principal Cities*

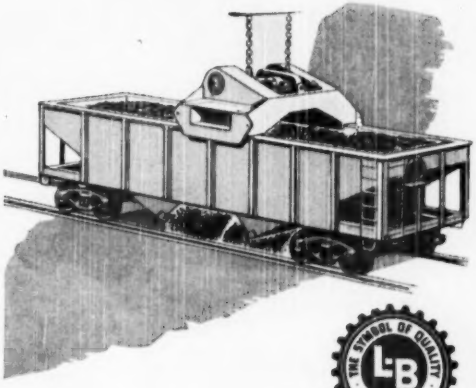
POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," "The Stationary Engineer"), April, 1950, Vol. 94, No. 4. Published monthly with an additional Directory number in June. McGraw-Hill Publishing Company, Inc. Editorial and executive offices, 330 W. 42nd St., New York 18, N. Y. Entered as second class matter January 26, 1949, at the post office at New York, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least 10 days for change of address. Subscription rates, U. S. and U. S. possessions, $5 for one year, $7 for two years, 65c per single copy. Canada $6 for one year, $9 for two years. Pan American Countries, $10 for one year, $16 for two years. All other countries $15 for one year, $25 for two years. Please indicate position and company connection on all subscription orders.



Now, you can unload bulk materials from hopper-bottom cars--
"broom-clean" and fast with

LINK-BELT CAR SHAKER

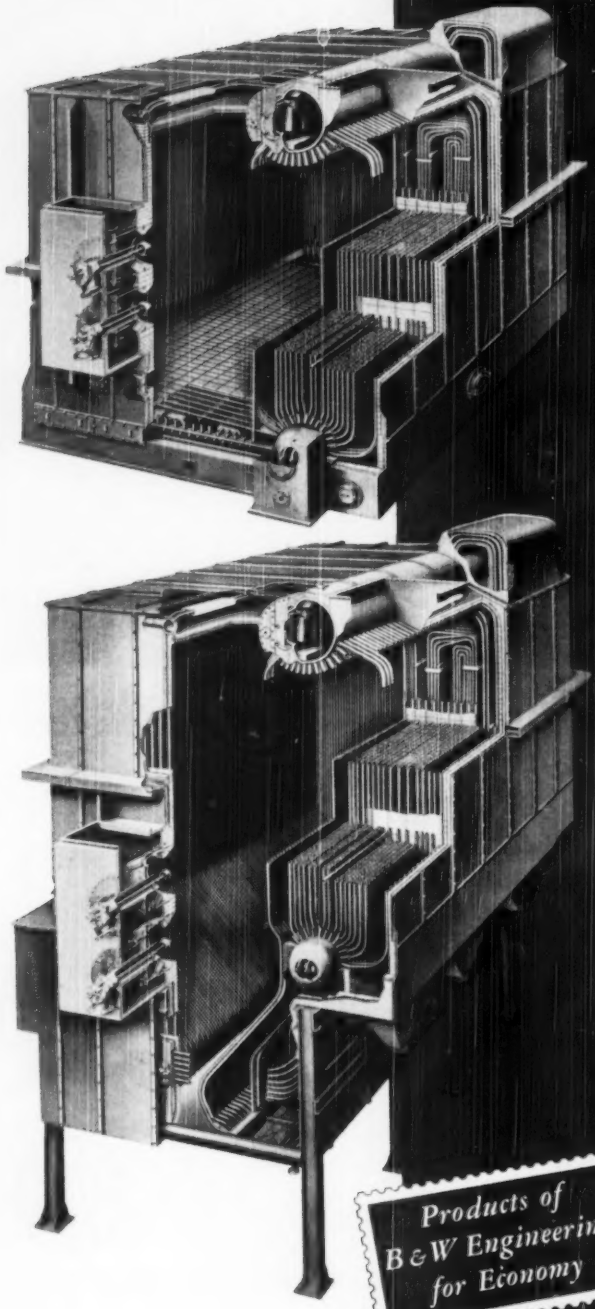
Lower the Link-Belt Car Shaker to the top of the car walls. Start the motor which delivers vibrations to the car sides and sloping hopper bottoms, loosening the material for easy "broom-clean" unloading in minutes. Reduce unloading costs and injury hazards and eliminate demurrage charges with this efficient unit. It is especially valuable for unloading damp or frozen materials. May we send you full information? Send for Book No. 2345.

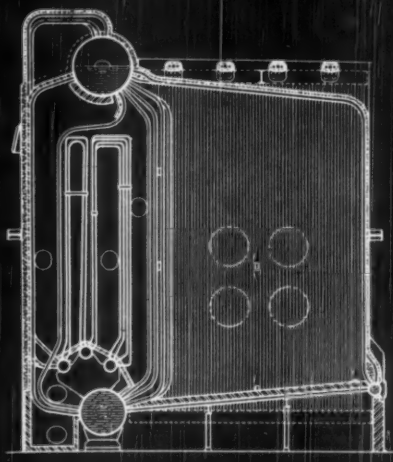


LINK-BELT COMPANY

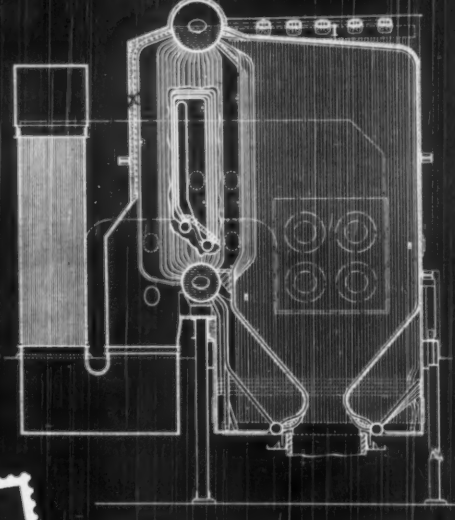
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Houston 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities. 11,598

B&W INTEGRAL-FURNACE BOILER TYPE FH





Left: B&W Integral-Furnace Boiler, Type FH, with flat floor for firing with oil and gas, separately or in combination. Above: Process plant installation arranged to burn five fuels — oil, gas, pulverized coal, and plant waste products.



Left: B&W Integral-Furnace Boiler, Type FH, with hopper bottom furnace, arranged for firing with pulverized coal. Above: Manufacturing plant installation arranged for coal-firing by B&W pulverizers.

Products of B&W Engineering for Economy

bringing NEW *Economies in Steam* to all industries

Manufacturing, process, and service industries all over the U. S. A. are finding the ideal answer to their new steam requirements in the B&W Integral-Furnace Boiler, Type FH. Installations range in steam capacity up to 350,000 lb. per hr. per unit, employing a wide diversity of fuels and firing methods, pressures to 1050 psi, and temperatures to 910 F.

An important advance in steam engineering, this B&W unit brings together in a modern, standardized design, all the best features of the original and highly successful Integral-Furnace Boiler, introduced by B&W 17 years ago, plus many additional improvements . . . each one time-tested and performance-proved.

Immediate and widespread acceptance—over 39 million pounds per hr. of steam capacity installed or ordered—is evidence that the Type FH Boiler satisfies all modern requirements for dependability, efficiency, accessability, adaptability, and economy of installation and operation.

It will pay you, as it has so many others, to consult B&W engineers about this boiler when planning steam plant expansion or modernization.

COST SAVING FEATURES OF B&W INTEGRAL-FURNACE BOILER, TYPE FH

HIGH AVAILABILITY, due to:
- Self-draining Superheater
- Continuous Ash Disposal
- Ease of Inspection
- Quick fuel changeover

HIGHLY DEPENDABLE, because of:
- Less Slagging
- Less Manual Cleaning
- Improved Soot Blowers
- Ease of Operation
- Improved Circulation: Clean, Dry Steam

HIGHLY ECONOMICAL, due to:
- Low Maintenance
- Minimum Space Requirements
- High Heat Absorption
- Fuel and Firing Flexibility

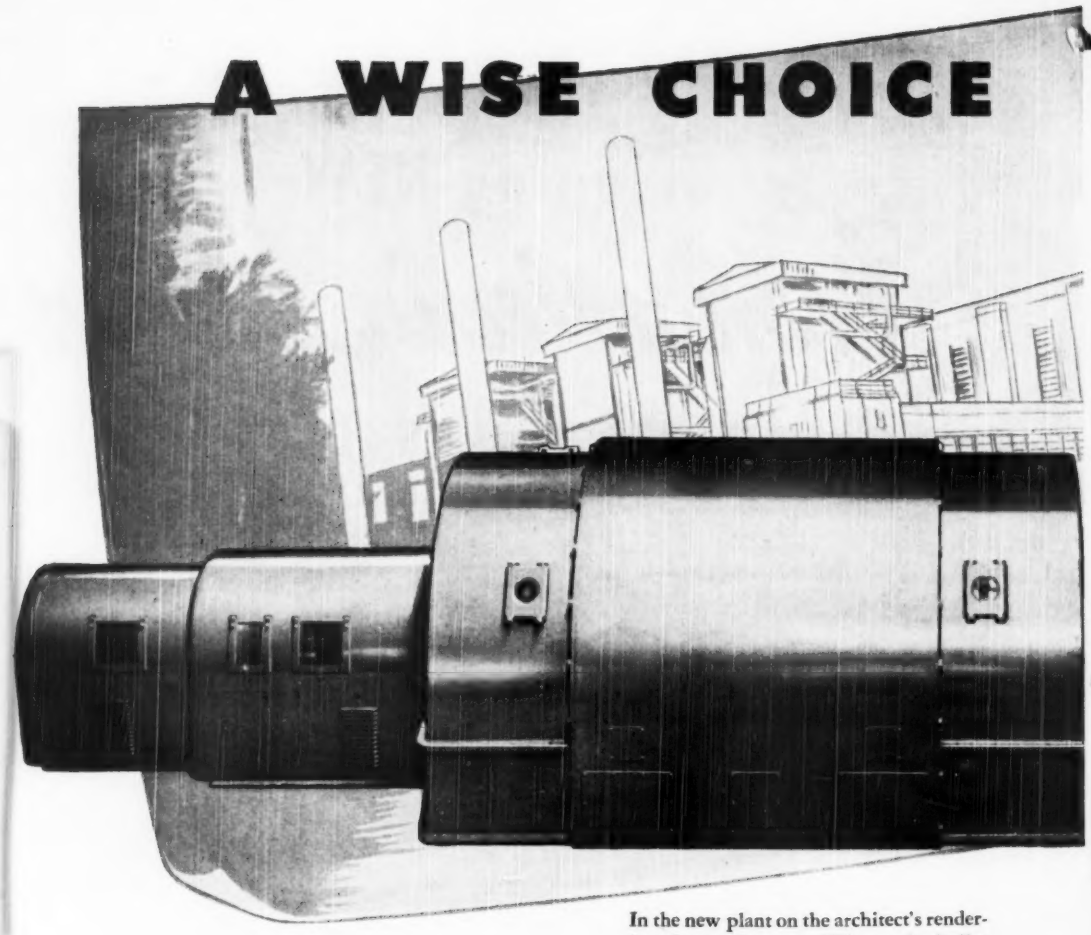
Send for Bulletin G-38 describing and illustrating features and showing typical applications of the Type FH boiler. The Babcock & Wilcox Company, 85 Liberty Street, New York 6, N. Y.

BABCOCK & WILCOX

Helping Industry Cut Steam Costs Since 1867

G-481

A WISE CHOICE



In the new plant on the architect's rendering shown above, an Elliott unit similar to the one pictured is now in service, with a duplicate unit on order. On the opposite page, the drawing shows another new plant which will house three Elliott turbine-generators — one of 11,500 kw, the other two of 7500 kw each.

ELLIOTT COMPANY

STEAM TURBINE DEPT.
JEANNETTE, PA.
Plants at: JEANNETTE, PA. • RIDGWAY, PA.
AMPERE, N. J. • SPRINGFIELD, O. • NEWARK, N. J.
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for these fine new plants-

TURBINE-GENERATORS

by ELLIOTT

YOU'LL find them in quite a few of the new medium-sized power generating plants—these sturdy, dependable Elliott turbine-generators.

The unit shown above, rated 11,500 kw, is typical of those which are selected for these stations. Its streamlined design and many superior features of construction in both driver and driven elements express the latest in modern engineering thought. Its reliability is a positive factor assuring not only satisfactory performance, but also a sound basis for close accuracy in the calculation of operating costs.

A new station gets off on the right foot for a long and successful career, when Elliott turbine-generators are selected as its basic equipment.

H-727

STEAM TURBINES • GAS TURBINES • GENERATORS • MOTORS • CONDENSERS
FEEDWATER HEATERS AND DEAERATORS • STEAM JET EJECTORS
CENTRIFUGAL BLOWERS • TURBOCHARGERS FOR DIESEL ENGINES
TUBE CLEANERS • STRAINERS • EXPANDERS • FILTERS

You don't get over

80% of the Sales

for 20 YEARS unless you give

far greater value

In the past 20 years, "Power" has published 11 surveys of central station power plants. 83.7% of the soot blower installations in the plants listed in these surveys were Diamond Soot Blowers.

You don't get persistent percentages like that unless your product consistently gives your customers a much greater value per dollar. This is certainly overwhelming evidence of the outstanding superiority of Diamond Soot Blowers, Diamond Application Engineering and Diamond Service.

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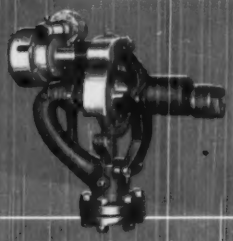
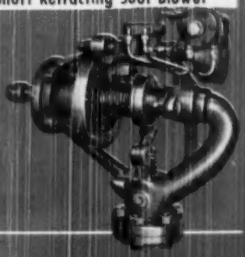
DIAMOND

DIAMOND Model G9B Soot Blower



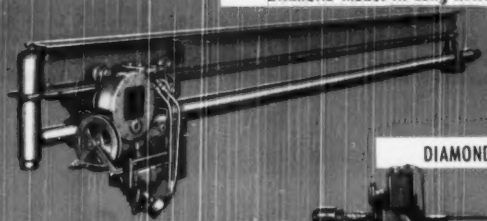
Multiple nozzle steam blower, automatic valved . . . goes through complete operating cycle as single chain is pulled or when driven by air (shown) or electric motor. Has flexible element connection and adjustable pressure control.

DIAMOND Model IS Short Retracting Soot Blower



Uses either air or steam as cleaning medium. Positive poppet type valve prevents leakage and flow until nozzle is in blowing position; lubrication unnecessary. Operation: air (shown), manual, or electric.

DIAMOND Model IK Long Retracting Soot Blower

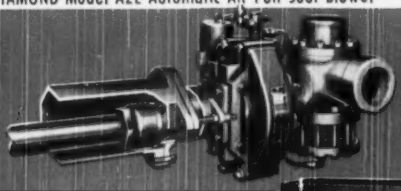


Uses steam or air to clean surfaces inaccessible to Model IS, where gas temperature is too high for permanently installed units. Lance tube is projected, rotated and retracted by single air (shown) or electric motor.

DIAMOND Telescopic Long Retracting Soot Blower

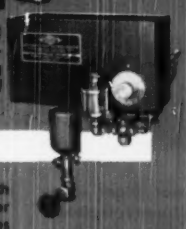
Used where clear space outside boiler is insufficient for Model IK Long Retracting Blower. Air or electric (shown) operation . . . uses steam or air as cleaning medium.

DIAMOND Model A2E Automatic Air Puff Soot Blower



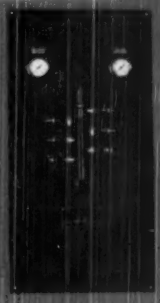
Cleans automatically with series of compressed air puffs delivered through a standard multiple nozzle blowing element. Spreading cleaning over longer period permits use of much smaller compressor and receiver.

DIAMOND Air Puff Master Controller



Automatically controls all A2E units to which connected. Operator opens one valve (either manual or automatic) . . . the controller does the rest.

DIAMOND Air Control Panel



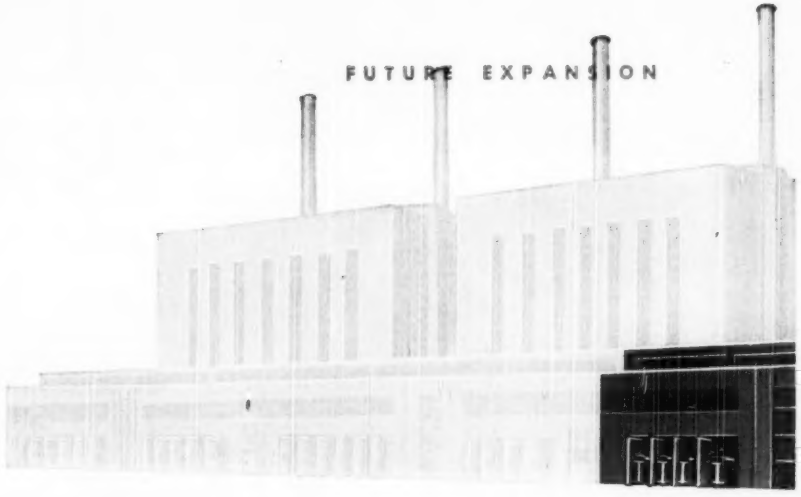
Controls automatic cleaning cycle of any arrangement of various types of blowers. Operator starts cycle simply by moving start and stop valve carrier to down position. Always shows status of cleaning cycle. No electrical connections whatever.

Soot Blowers

SUNBURY

a tradition of leadership

On the evening of July 4th, 1883, Thomas A. Edison placed in operation the first three-wire central station electric lighting plant in the world at Sunbury, Pa. Power was supplied to the old City Hotel three blocks away which was then on the site now occupied by the Hotel Edison.



The world's largest power plant using pulverized anthracite has been completed recently on a site near Shamokin Dam along the Susquehanna River about two miles below Sunbury, Pa. This 150,000 kw installation, first of a number planned for the site, is part of the Pennsylvania Power & Light Company's network serving 28 counties which cover an area of 9,500 sq miles in central eastern Pennsylvania.

The two 75,000 kw turbine generators are served by four 130-ft high Foster Wheeler Steam Generators, the largest ever built for direct firing of pulverized anthracite.

An extension of 100,000 kw capacity, now under construction, will be completed in 1951 and equipped with Foster Wheeler Steam Generators.

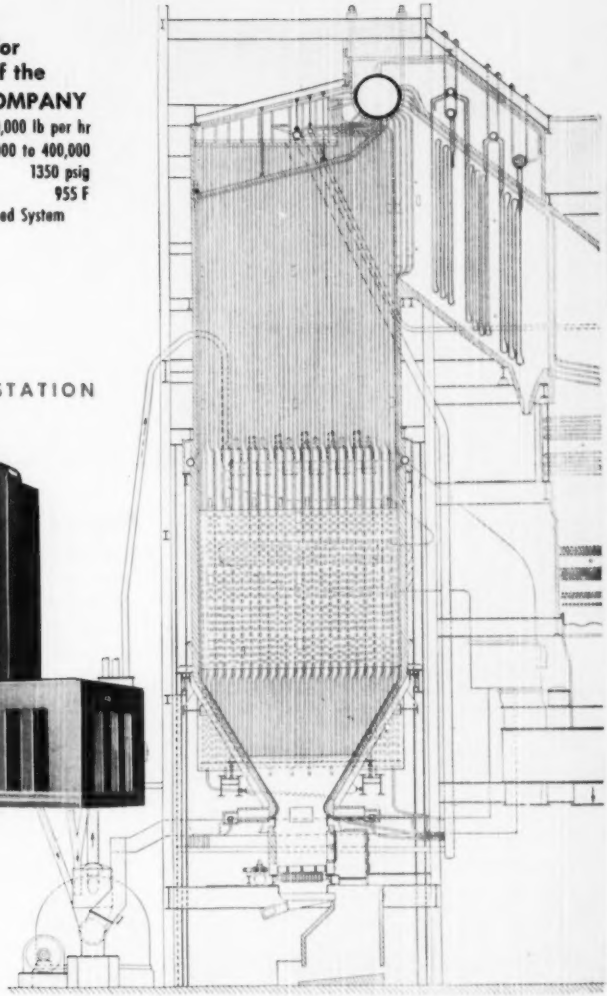
FOSTER WHEELER CORPORATION • 165 BROADWAY

still lights the way

Four FOSTER WHEELER Units for
Sunbury Steam Electric Station of the
PENNSYLVANIA POWER & LIGHT COMPANY

Capacity	400,000 lb per hr
Superheat Control Range	250,000 to 400,000
Pressure Superheater Outlet	1350 psig
Final steam Temperature	955 F

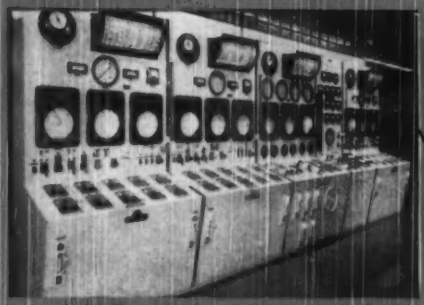
Anthracite Coal Pulverized in FW Ball Mills in Direct Fired System



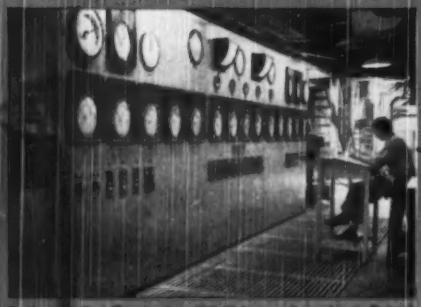
Each steam generator is equipped with two Foster Wheeler ball mill pulverizers which have a combined output of 27 tons of coal per hr.

FOSTER WHEELER

NEW YORK 6, N. Y.

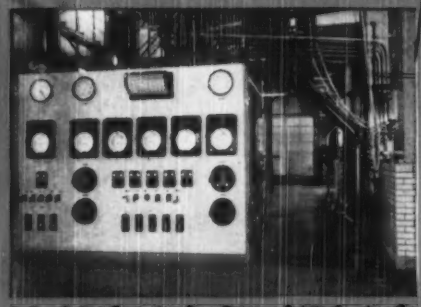


Bailey Boiler Control—Gas or Oil Firing—Pacific Gas & Electric Co., Avon Station.

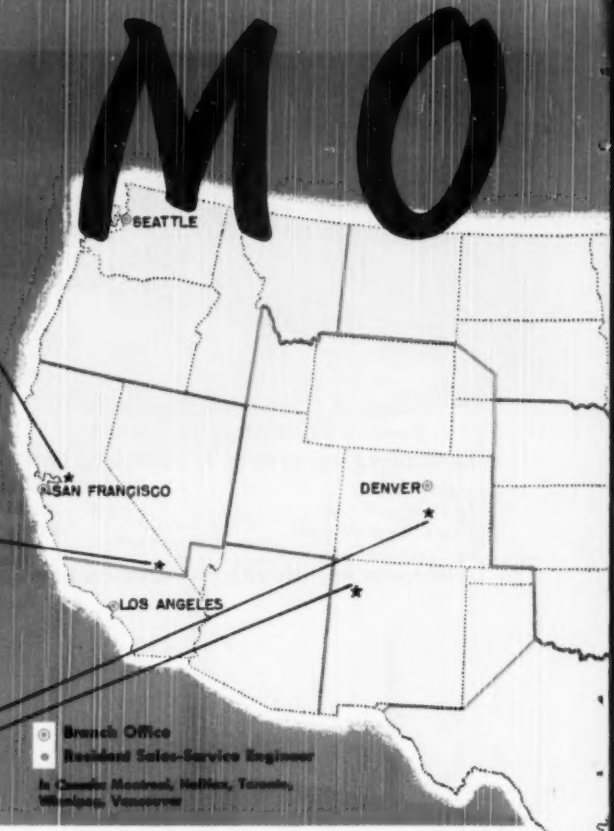


Bailey Boiler Control—Oil Firing—American Potash and Chemical Corp., Trona, Calif.

Bailey Boiler Control—Gas Firing—Colorado Fuel and Iron Corp., Pueblo, Colo.



Bailey Boiler Control—Gas Firing—Public Service Co. of New Mexico, Albuquerque, N. M.



More Power per fuel dollar—that's the basic business of Bailey Meter Company. Our products and services are designed to deliver increased power plant efficiency for you, whether your plant is large or small. We have had a wealth of experience on every size and type of steam generating equipment.

Here are some of the reasons why we believe we have more to offer you in this field than any other single manufacturer:

More Complete Range of Equipment

Our fully co-ordinated line of Meters and Controls is offered for a wide variety of services and in a complete range of types. This means you need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment merely because he is unable to offer the exact one best suited to your needs. It means, too, that you need never fear a buck-passing division of responsibility for the efficient operation of your complete boiler control system.

More Experienced Engineering Service

When you discuss your power plant problems with a Bailey Sales-Service

Giving More Power to You...

CONTROLS for—Combustion • Feed Water • Temperature • Pressure • Liquid Level • Feed Pumps

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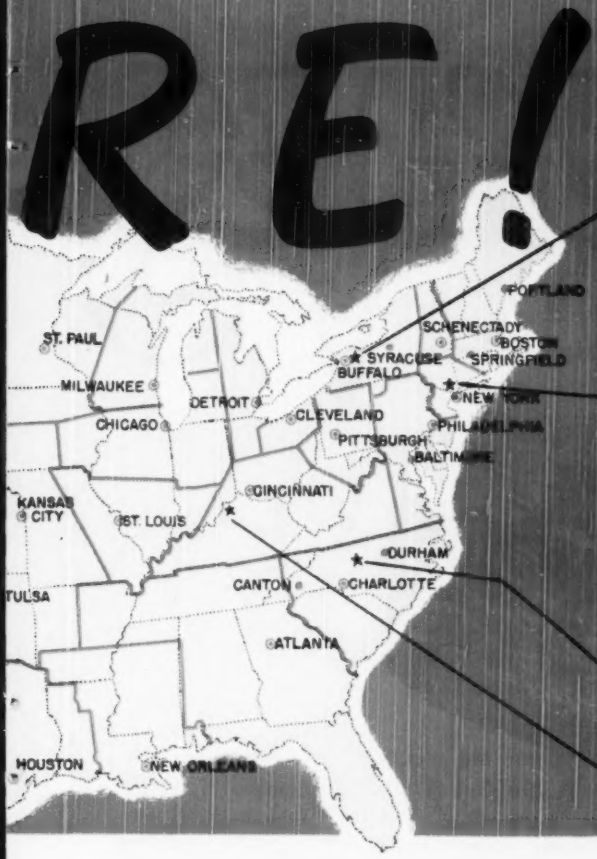
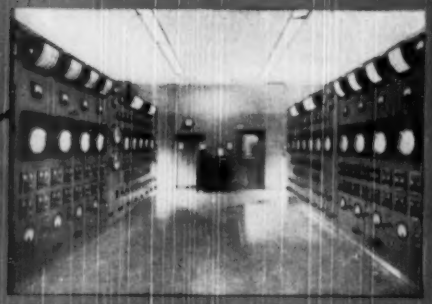
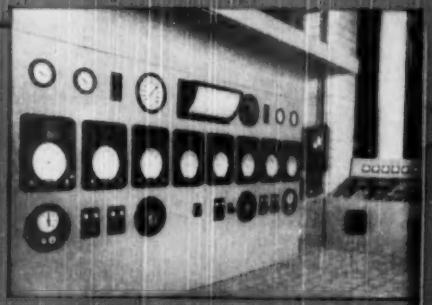


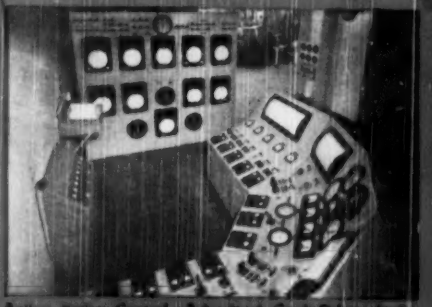


Bailey Boiler Control—Pulverized Coal Firing—Buffalo Niagara Electric Corp., Huntley Station No. 2.



Bailey Boiler Control—Pulverized Coal Firing—Rockland Light and Power Co., Tomkins Cove, N. Y.

Bailey Boiler Control—Stoker Firing—Hanes Dye and Finishing Co., Winston-Salem, N. C.



Bailey Boiler Control—Pulverized Coal Firing—Louisville Gas and Electric Co., Paddy's Run Station.

Engineer, you get advice from an organization with a background of more knowledge and experience in steam plant operation than any other manufacturer of instruments and controls can offer you. Our field representatives are graduate engineers with specialized training in combustion, flow measurement and automatic control. Each has completed an intensive course in theory and practice at our plant before being given a field sales-service assignment.

More Direct Sales-Service Offices

Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems. Truly, prompt and capable service—and with a minimum of travel time and expense—is as near as your telephone. In emergencies a trained Bailey Engineer is available in a matter of minutes or a few hours at the most.

Giving More Power to You

Better power plant operation calls for more power per fuel dollar, less outage, and safer working conditions. We help you to get all of these. Write for Bulletin 15G describing Bailey Meters and Control Systems.

Bailey Meter Company

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LOW PRICED COAL TAILINGS

to **LOW COST KWS**

Ask for a copy of 97-page Engineering Bulletin No. 44-B containing valuable information on preparation of pulverized fuel and steam generating plants.

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Kennedy Van Saun welcomes the opportunity to furnish complete steam power plants . . . from coal bunkers to bus bars. As specialists in superfine pulverization of coal, high efficiency combustion and economical steam generation, our engineering, production and installation facilities assure competent interpretation of requirements and carrying out of every detail involved in equipping a plant for low cost power production. A very low KW rate can be expected because KVS equipment is capable of handling low grade coals such as screenings, washings and tailings not ordinarily used.

Our service includes furnishings and installing prime movers, electrical units and auxiliary equipment in addition to that regularly built in KVS shops.

This complete service is available through Kennedy Van Saun for plants installed in any part of the World. Through it, Kennedy Van Saun assumes full responsibility for meeting all performance guarantees before turning a plant over, in operation, to its owners.

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ARMY E NAVY

in Mechanical Drive Turbines

TYPE DP

For flexible speed control, performance accuracy, and on-the-job reliability, you can't beat a General Electric standard DP turbine with its totally-enclosed hydraulic governing system.

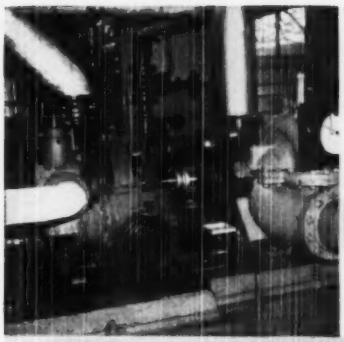
This pressure-relayed system gives you ease and accuracy of control that compares with the precision speed governing of large central station turbines. Yet the DP is a standard design, sold at standard prices.

YOU GET A WIDE SPEED RANGE—30% adjustment for flexibility of operation. This feature, combined with the wide variety of ratings and speeds available, provides you with the "right" turbine for any job.

YOU GET PERFORMANCE ACCURACY—6% regulation means holding the speed you want on important processes. Regulator control is available for governing in terms of any process requirement.

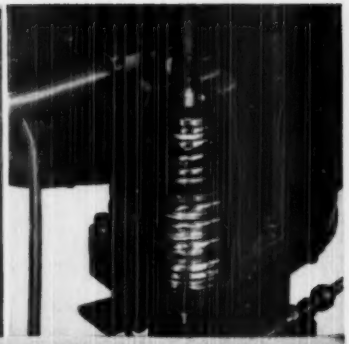
YOU GET GREATER RELIABILITY—the hydraulic governing system keeps moving parts to a minimum, operates in an oil atmosphere with no exposed linkages. This eliminates wear and corrosion, assures dependable operation.

Check the features of the standard DP. It can give you the kind of precision performance you're looking for, the savings in operating costs that boost profits. Contact your nearest G-E sales office, or write for bulletin GEA-4955A. Apparatus Dept., General Electric Co., Schenectady 5, N. Y.



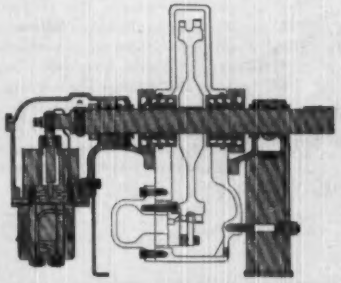
In this plant, a General Electric 30-hp DP turbine is coupled to a centrifugal pump. The hydraulic governing system provides accurate, reliable performance over a wide range of speed adjustment.

This turbine-type oil pump, gear driven from the main shaft, signals any tendency for the DP to speed up or slow down with changes in load. The pump also provides oil pressure for positioning the governor valve.



Acting on the speed signal from the oil pump, this pressure relay controls the amount of oil pressure in the operating cylinder. This cylinder regulates the amount of steam admitted to the turbine through the governing valve.

HYDRAULIC GOVERNING makes a difference

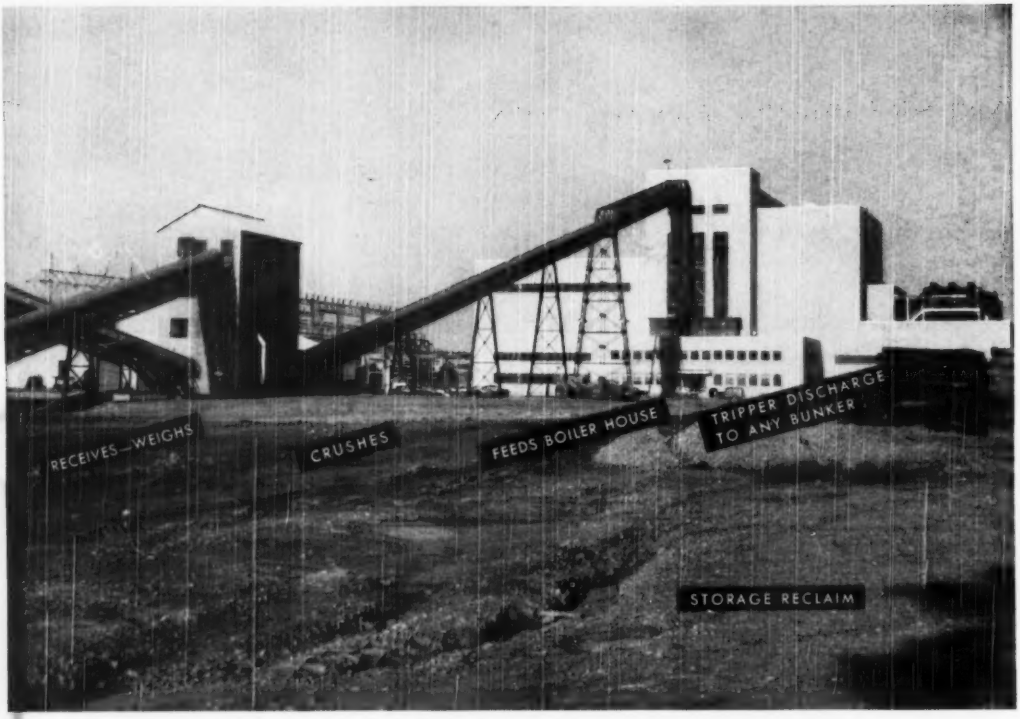


Here's What Standardization Provides For You

In the diagram at the left, all shaded parts are interchangeable on all sizes of DP turbines. Thus, it is easy to stock spares, and maintenance costs are reduced. All models have standard shaft height and coupling fits for easy installation or re-location in your plant. Standardization cuts manufacturing expense and the savings are passed on to you in the form of extra features usually found only on "special" turbines.

GENERAL ELECTRIC

252-44



6-Station Continuous Coal Handling System

Features Reserve Capacity up to 300 tons per hour

Designed by S-A engineers, this coal conveying system meets every need of a large Eastern power generating station. It is capable of handling as much as 300 tons per hour feeding coal direct to bunkers . . . or to outdoor storage for later reclaiming . . . a versatile job at lowest cost per ton.

Over the past half century, S-A engineers have designed handling systems for every type of industry—coal and ash systems for every variation of handling and for small or vast operations. One basic requirement in all such systems is to move maximum tonnage under strict cost limitations.

Before you make any change in your present system let S-A engineers present their recommendations for improvement. This service will cost you nothing . . . may save you much. Write today.

Coal delivered by rail is dumped into double track hoppers where plate feeders feed it to 250 foot long inclined belt conveyor which takes it through weighing station to crusher house. A second belt conveyor, 440 feet long, conveys coal to power house where tripper discharges belt over any part of bunkers. Coal not immediately needed at power house is transferred at the crusher house to a separate 190 foot long inclined belt conveyor which takes it to stocking-out tower for distribution to outdoor storage. Coal reclaimed to track hopper feeds back into conveyor system to boiler house.

STEPHEN S-A DAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois · Los Angeles, Calif. • Belleville, Ontario

DESIGNERS AND MANUFACTURERS OF ALL TYPES OF BULK MATERIALS HANDLING EQUIPMENT

Schooled to serve you...

YOU benefit when these men go to school!

These men are Standard Oil lubrication specialists, skilled and experienced in the use of modern lubricants. They are representative of the groups who come year after year from Standard Oil Company (Indiana) sales fields throughout the Midwest to learn about new machinery and the most up-to-date methods of lubricating them. In lecture rooms and in well-equipped laboratories, they are taught new ways to raise economy and efficiency of your operations.

The benefits held out to you by these lubrication specialists are multiplied by a service-distribution set-up that is unique in the oil industry. To serve your midwest operations, Standard Oil has located practically right in your own backyard a completely stocked warehouse and the office headquarters for a lubrication specialist. The nearness of this service-supply center *means faster deliveries to you* of necessary fuels and lubricants. It assures you of getting the product you need when you need it. It puts the services of the lubrication specialist at your immediate disposal.

These advantages are well worth investigating. Arrange, now, for the visit of a lubrication specialist. If your plant is located in any of the states below, simply phone your nearby Standard Oil service-supply center or write to: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

3 IMPORTANT ADVANTAGES

Standard Oil's Lubrication Service is especially geared to serve your midwest operations.

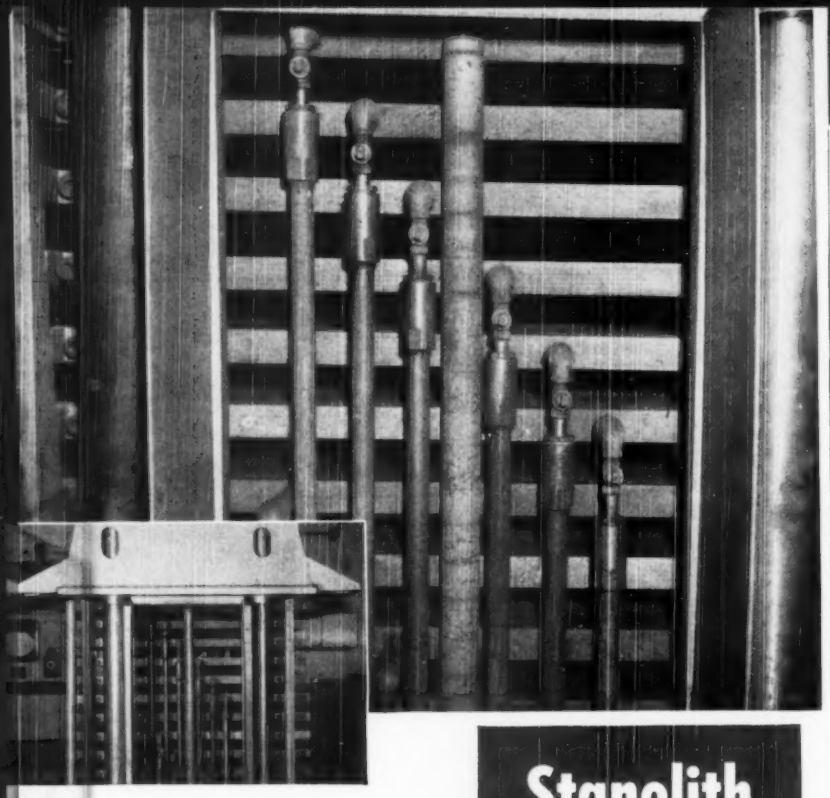
1 SERVICE-SUPPLY POINTS are near your plant. You are assured of fast deliveries, prompt lubrication engineering service.

2 LUBRICATION SPECIALISTS have been specifically trained in Standard Oil Lubrication Engineering Schools to help you obtain the maximum benefits from lubricants and fuels.

3 RESEARCH AND TECHNICAL FACILITIES are geared to help solve your specific lubrication problems.

Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Montana, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Wisconsin, Wyoming

STANDARD OIL COMPANY (INDIANA) STANDARD



What's YOUR problem?

D. R. Clay, lubrication specialist at Standard Oil's Grand Rapids office, solved this problem.

He is one of a corps of Standard Oil lubrication specialists located throughout the Midwest to provide "on-the-spot" service to plant operators. One of these lubrication specialists is near your plant. He has plenty of practical experience and has been specially trained for his job in a Standard Oil Lubrication Engineering School. You can obtain his services quickly and easily. Just phone or drop a card to the nearest Standard Oil Company (Indiana) office. Why not arrange, now, to discuss with him the advantages offered by these widely accepted lubricants?

STANOIL Industrial Oils—This multi-purpose line of oils provides cleaner operation of hydraulic units, supplies effective lubrication in compressors, gear cases, and circulating systems. One or two grades can replace a wide variety of special oils and lubricants.

SUPERLA Greases—Available in all consistency grades, SUPERLA Greases cover a wide range of applications. These products are comparable in quality to the highest type of special greases but are as readily available and economical as ordinary cup greases.

CALUMET Viscous Lubricants—On open gears and wire rope, these greases strongly resist washing and throw-off. Their superior wetting ability affords better coating of gears and chains, better internal lubrication of wire rope.

STANORUST Rust Preventives—The eight grades of STANORUST form one of the most complete and effective lines of rust preventives on the market today. Each has been scientifically and specifically developed for its intended use. The grades range from a finger print remover to a heavy petrolatum that protects against corrosion for years under the most severe outdoor exposure.

Stanolith Grease

Stops trouble on steam joints . . .

● Lubrication of the telescopic steam joints on a hot-plate veneer press was a continual problem for a midwest manufacturer. The job required a grease that would withstand temperatures of 240° to 260° F. and the severe washing action of steam and water.

Conventional greases failed to meet these requirements. Joints had to be lubricated frequently. This interfered with production and resulted in excessive consumption of the lubricant.

A Standard Oil lubrication specialist suggested that STANOLITH Grease No. 57 be used. This is a lithium soap product capable of standing up under high temperatures and of resisting the washing action of water. Since the switch to STANOLITH the joints have been lubricated between shifts with no interruption of production. *Lubricant consumption has been reduced 40%.*

Where the combination of heat and water causes lubrication difficulties, try STANOLITH Grease. To help you secure maximum benefits from such products, Standard Oil has a specially trained and experienced lubrication specialist located within easy reach of your plant. How you can take advantage of his services is explained at the right.

Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY (INDIANA)

Pair of Aces —BACK TO BACK!

ALLIS-CHALMERS BOILER FEED PUMP

The barrel pump, below, is one of three types we build for boiler feed service. The various features of this pump have been exhaustively tested and proved satisfactory for highest pressure requirements.

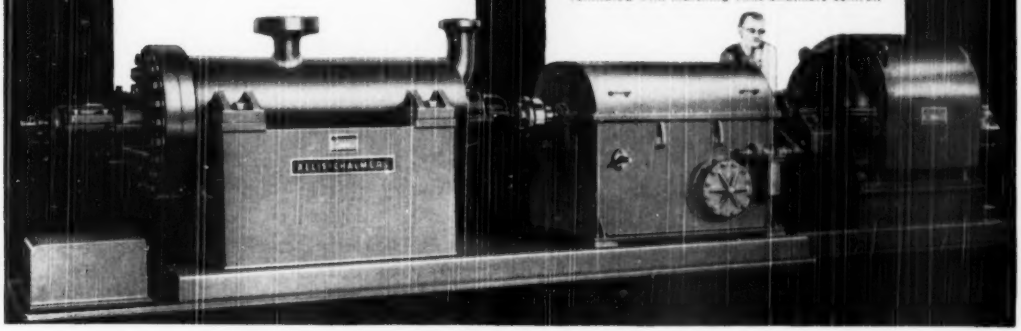
▶Back-to-back arrangement of stages and double volutes assure good axial and radial balance for high heads per stage. ▶Split inner casing simplifies maintenance. ▶Main horizontal joint of inner casing uses full hydraulic discharge to keep joint in compression. ▶Special design reduces possibility of flashing. ▶Uniform metal section thickness throughout volute casing equalizes expansion.

A-C 2-POLE MOTOR & CONTROL

The main thing you pay-for and want in a boiler-feed pump drive is *reliability* . . . continuity of service with minimum time-out!

Here is how you get it in Allis-Chalmers two-pole motors: ▶Extra insulation protection built into the stator winding. ▶Improved bearing design eliminates oil leakage. ▶Bracket (housing) bearing construction results in easier mounting and alignment, greater rigidity. ▶Special, non-embrittling copper used in rotor rods. Rods silver brazed to end rings.

Available for indoor or outdoor application — drip-proof or splash-proof; water-cooled; tube-type totally-enclosed fan-cooled; or pipe-ventilated with *matching* Allis-Chalmers control.



HERE'S A COMBINATION that's hard to beat . . . a quality boiler feed pump, reliable 2-pole motor, and control — all Allis-Chalmers-*built* and *backed!*

CHOICE OF 3 TYPES OF PUMPS

At the pump end, depending on the head, capacity and pressure conditions you are figuring, you can select from 3 different designs:

☛the new barrel-type, for larger steam stations operating against the higher pressures, 1200 to 2500 lbs; 300 to 2000 gpm.

☛the "Doubleton", for pressures between 1200 and 1800 p.s.i.

☛or the standard Type "M", for pressures usually under 1200 p.s.i.

READ WHAT USERS SAY

Regardless of which type of pump you finally select, it will keep your maintenance costs down to a rock-bottom figure. Here's what power plant people, themselves, say.

After 45,000 hours, "No measureable wear on shaft sleeves, rings or internal parts." 1250 p.s.i., 735 gpm pumps at an Eastern utility.

After 82,000 hours, "Not .001 in. wear on any internal part." 6 x 4, 5-stage pumps at Midwest utility.

"Only .002 in. wear on rings" after 8 years operation on pumps installed in 1937. On the strength of this performance, this Ohio utility re-ordered three 1800 p.s.i. pumps.

And on three, 800 hp, two-pole motors driving boiler feed pumps in a Midwest utility, "In over 20 years of uninterrupted service we've had to order replacement parts twice at a total cost less than $12 a year!"

GET AN ALLIS-CHALMERS "PUMPING PACKAGE"

If you want this kind of performance in your power plant, get in touch with an A-C pump application engineer today.

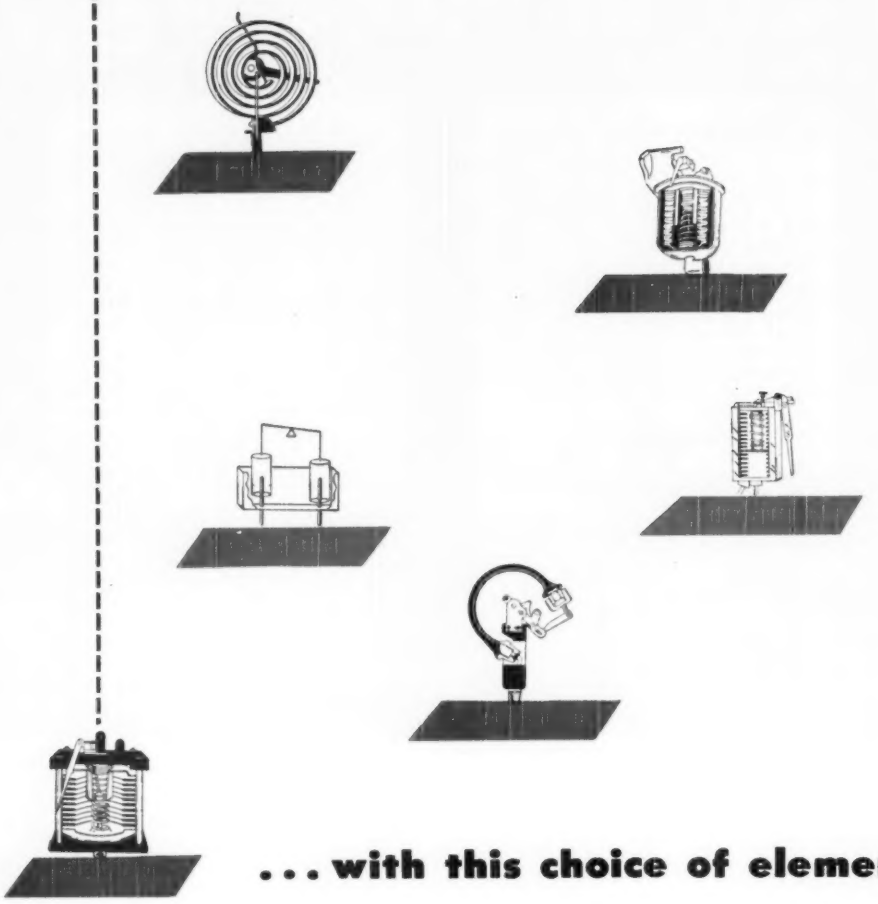
He'll show you how a complete Allis-Chalmers "Pumping Package" . . . pump, motor and control . . . can keep you time, trouble and money ahead in the long haul.

A-2098

ALLIS-CHALMERS, 952A SO. 70 ST. MILWAUKEE, WIS.

ALLIS-CHALMERS

ONLY BROWN GIVES YOU



. . . with this choice of elements

WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

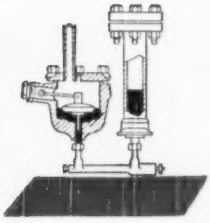
COMMERCIAL · RESIDENTIAL · INDUSTRIAL

MINNEAPOLIS-HONEYWELL REGULATOR CO. • BROWN INSTRUMENTS DIVISION

4490 Wayne Ave., Philadelphia 44, Pa.

Offices in 77 principal cities of the United States, Canada and throughout the world

THE PRESSURE GAUGE



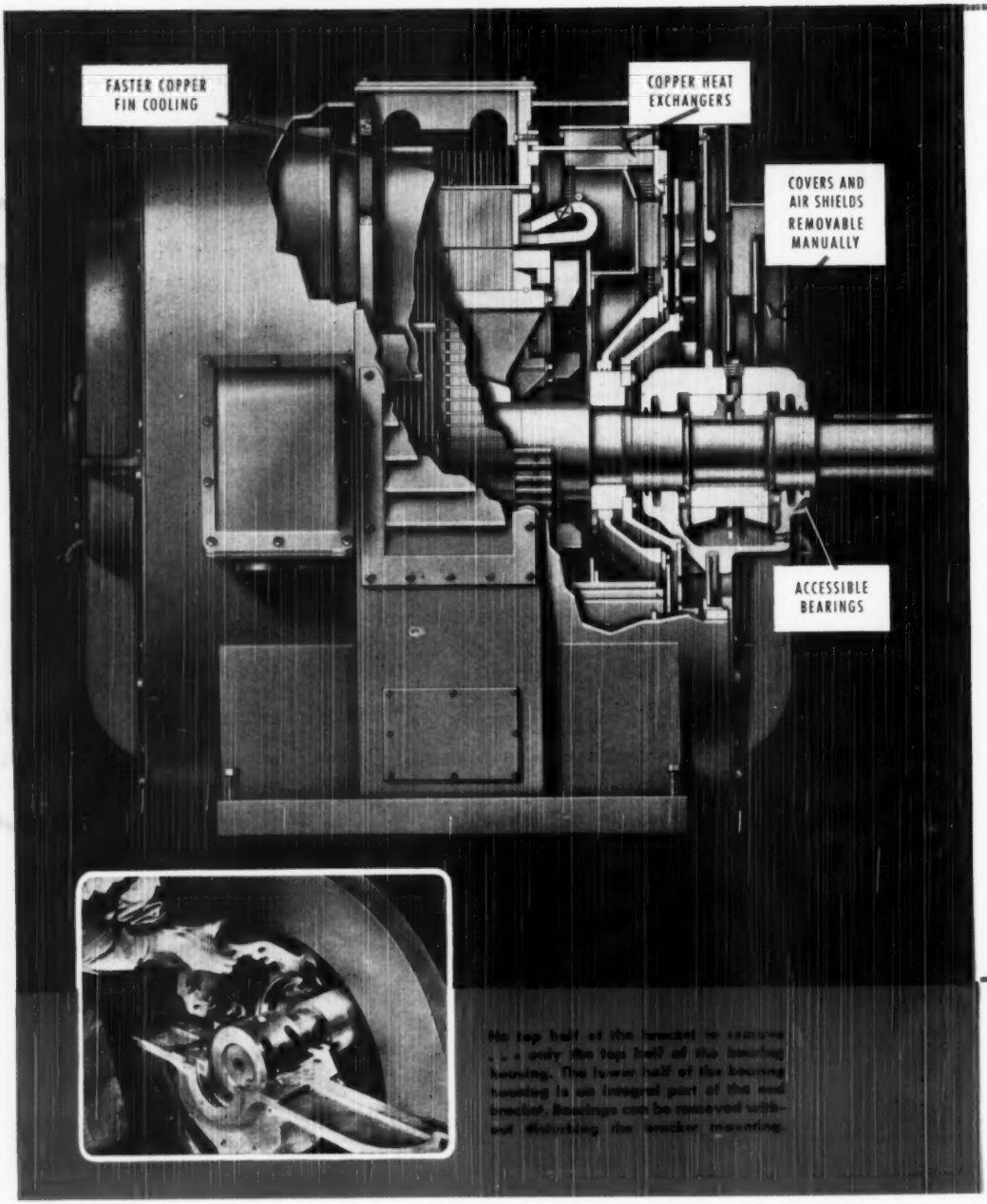
THE BROWN PRESSURE GAUGE has long been the standard of comparison for almost all of industry... because of its continuous, trouble-free performance and its unmatched sensitivity.

Its performance is the result of engineered design, rugged construction and simplicity of operation. The wide range of measuring elements is responsible for its sensitivity. There's a specific element for every pressure application... from microns to tons ... from corrosive to non-corrosive.

Your local Honeywell engineer is as near as your phone. Call him in for a discussion of your pressure problems... or write for a copy of Catalog 7000!

Honeywell *Advanced Instrumentation* FOR BETTER PROCESSING BROWN

YOU CAN BE **SURE**.. IF IT'S
Westinghouse



No top half of the bracket to remove . . . only the top half of the bearing housing. The lower half of the bearing housing is an integral part of the end bracket. Bearings can be removed without disturbing the motor mounting.

NEW LARGE INDUCTION MOTOR DESIGN

offers important advance in totally-enclosed, fan-cooled motors

Transfer of heat from totally-enclosed, fan-cooled, large motors is now accomplished more efficiently . . . more effectively.

New Westinghouse design and construction employ copper cooling fins to quickly dissipate heat from motor windings and stator core. Heat exchangers, also utilizing copper fins, provide efficient transfer of heat from internal circulating air into the path of the external cooling air. Further, this design permits totally-enclosed construction on frames which *require little more installation space than open motors* of the same rating.

Also included in the new Westinghouse Totally-enclosed, Fan-cooled Motor are basic design improvements common to other enclosure types of Westinghouse large motors. Many are features that contribute appreciably to lower installation and maintenance costs.

For example: sectional covers and air shields, easily removable, by hand; split bearing housings, with bearings readily accessible for inspection or replacement—without removing lower half of housing; sturdy frame of welded steel construction—stronger, smaller in size and lighter in weight.

Get the facts now—for immediate use or with an eye toward future requirements.

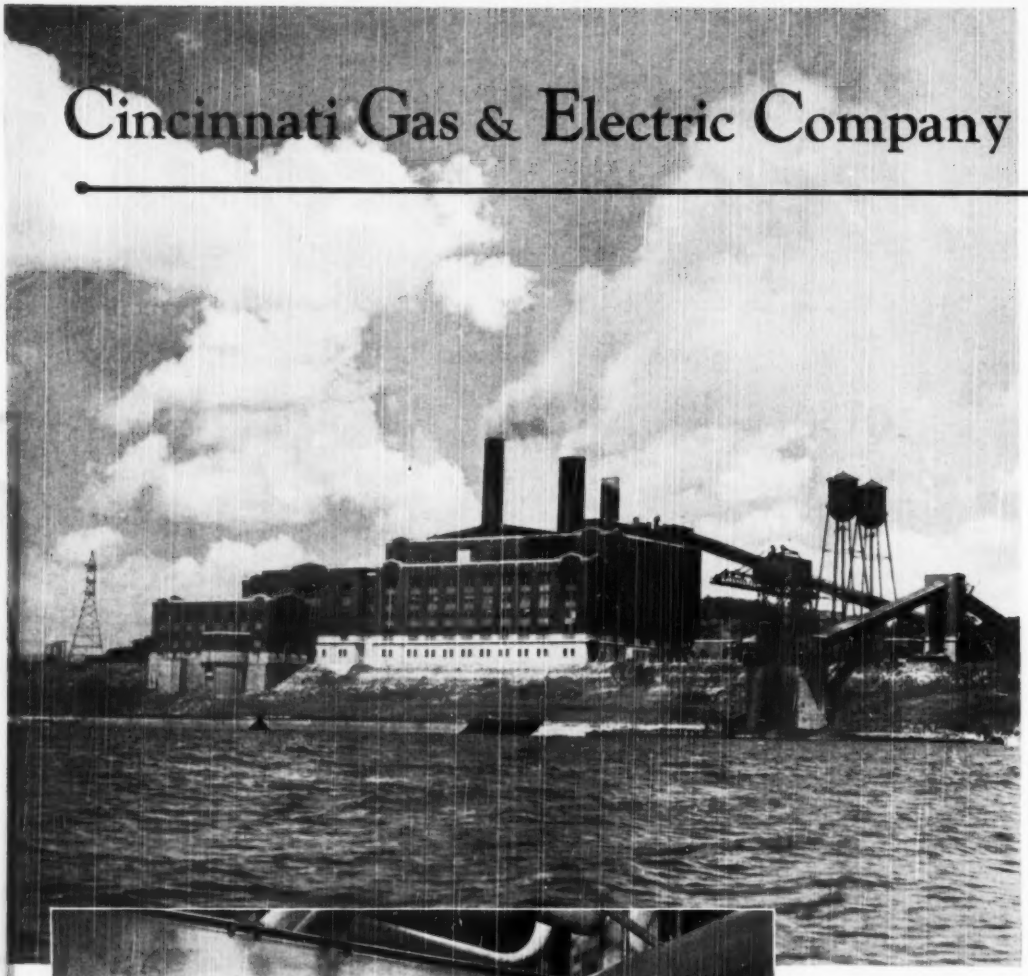
See your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-21552

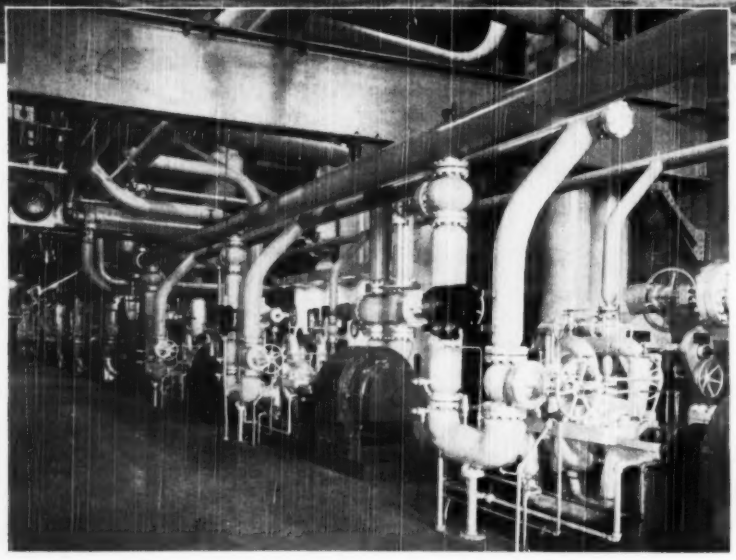
Westinghouse

LARGE INDUCTION MOTORS

Cincinnati Gas & Electric Company



Miami Fort
Power Station



Leadership through Achievement

supplies

...MORE POWER TO INDUSTRY THROUGH LUNKENHEIMER VALVES

AMERICA'S never-ending demands for more power are being met by power plants across the nation. "Almost 6,000,000 kw were added in 1948 and 1949, and 1950 will run about ten per cent higher," comments a reliable source. By 1957, the total installed central power capacity should be about 90 million kilowatts.

A good example of construction to restore a safe reserve in capacity are the views shown here of Cincinnati Gas & Electric Company, one of the midwest's well known power producers. Long a user of LUNKENHEIMER Valves, C. G. & E. has specified quantities of a large variety for expansion programs recently completed or still under construction.

Among these are steel, iron and bronze valves . . . globe, gate, angle, check, non-return and blowoff patterns . . . for services ranging from main steam at 1250 lb. 950° F. and boiler feed lines at 2000 lb. 450° F. downward to 125 lb. valves. LUNKENHEIMER Breech Lock Seal Welded Bonnet Cast Steel Valves are well represented.

If you are planning an expansion or the addition of new power plant units, Lunkenheimer representatives and sales engineers can give you helpful cooperation. Their wide experience and technical facilities are at your service.

ESTABLISHED 1862

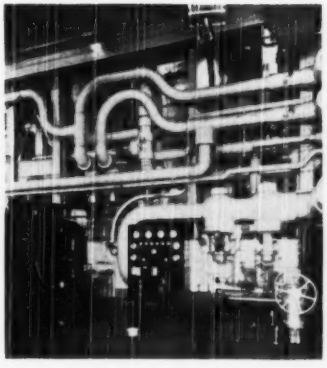
THE LUNKENHEIMER CO.

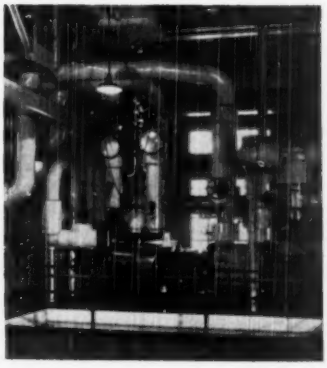
"QUALITY"

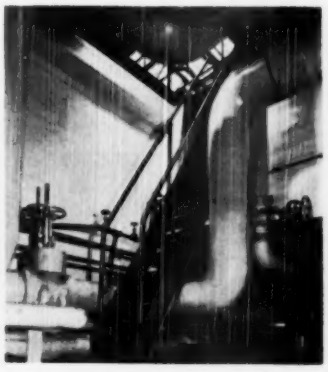
CINCINNATI 14, OHIO, U.S.A.

NEW YORK 13 • CHICAGO 6 • BOSTON 10 • PHILADELPHIA 34

EXPORT DEPT. CINCINNATI 14, OHIO, U.S.A.







GUN-PAKT EXPANSION JOINTS

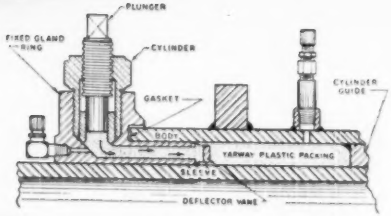
COST LESS

to maintain

require

NO SHUTDOWNS

for servicing



Close-up of cross-section showing detail of Gun-Pakt feature.

YARWAY

Maintenance costs are less because there's less maintenance.

In a nutshell, that's why more and more utilities, institutions and industrial plants distributing steam are turning to Yarway Gun-Pakt Expansion Joints.

Servicing Gun-Pakt Joints never interrupts heating or production. They are serviced under full steam pressure, without shutdowns.

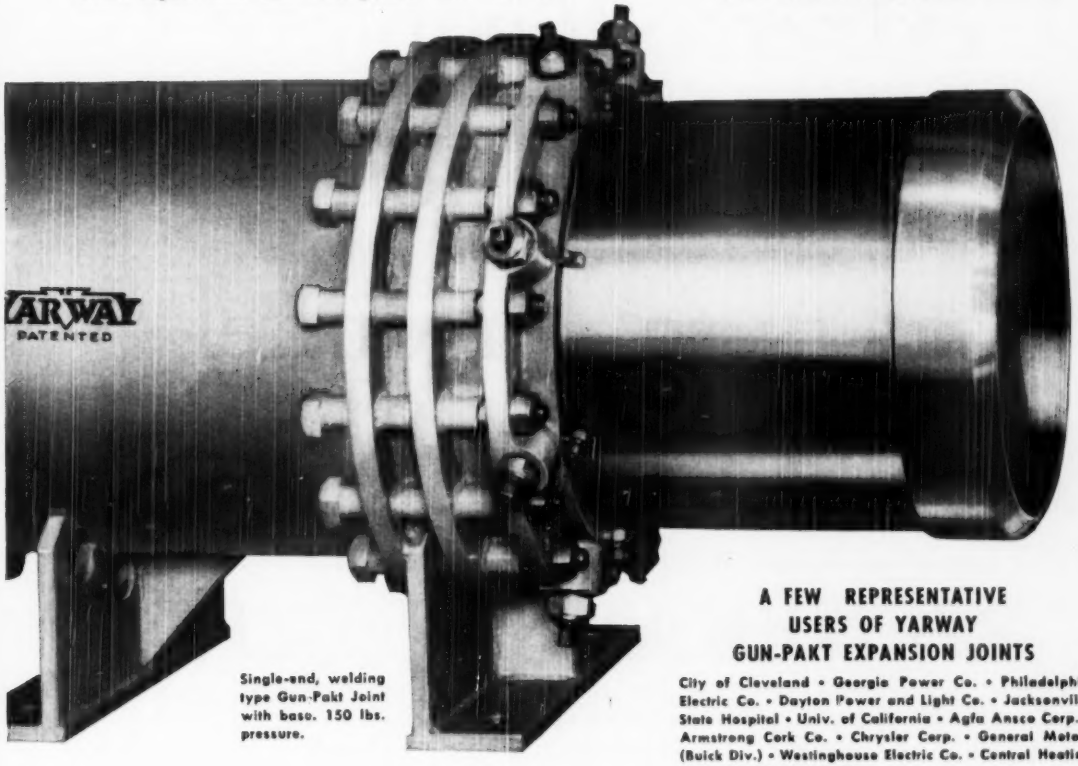
To repack a Gun-Pakt Joint you simply insert a plug of plastic packing, turn a wrench, and the job's done. Special Alemite fittings provide for proper lubrication.

Users report that Gun-Pakt Joints cost little to maintain. One who has kept accurate records says "65 cents per year per joint." Others claim even less.

Available with single or double ends, welding or flanged types, in sizes from 2" to 30", with traverses from 4" to 24", and for pressures to 400 psi.

For the full Gun-Pakt story, as well as information on other Yarway slip-type joints, write for Yarway Bulletin EJ-1912.

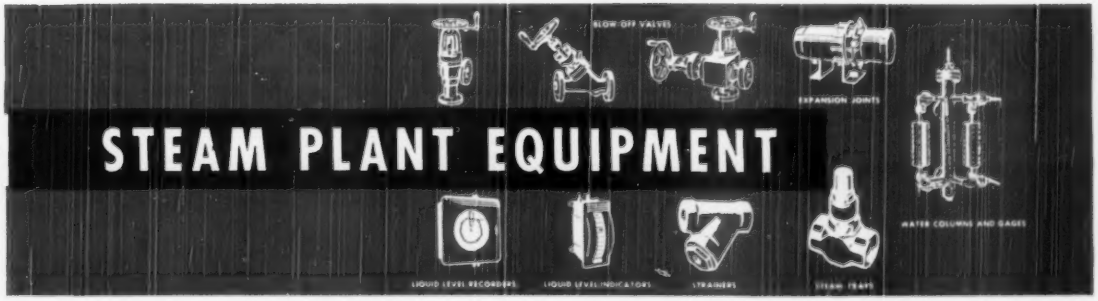
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities



Single-end, welding type Gun-Pakt Joint with base. 150 lbs. pressure.

A FEW REPRESENTATIVE USERS OF YARWAY GUN-PAKT EXPANSION JOINTS

City of Cleveland • Georgia Power Co. • Philadelphia Electric Co. • Dayton Power and Light Co. • Jacksonville State Hospital • Univ. of California • Agfa Ansco Corp. • Armstrong Cork Co. • Chrysler Corp. • General Motors (Buick Div.) • Westinghouse Electric Co. • Central Heating Plant, Washington, D. C.



Macy's

San Francisco

gets

extreme flexibility

to handle load changes and future load growth

low installation cost

everything was shipped complete—as a unit—and easily installed

safety to personnel

no exposed circuits; metal encloses all current-carrying parts

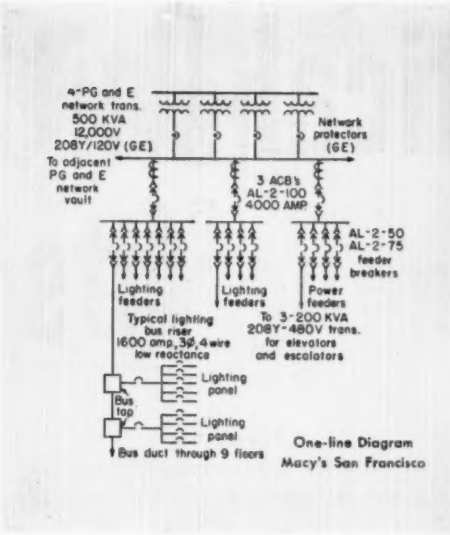
plenty of "IC"....with

100,000 amperes interrupting capacity, adequate to handle all short circuits

GENERAL ELECTRIC

HERE'S WHY . . . "In the department store business we cannot take any chances with power outages or potential fire hazards. We must also plan for expansion. That's why we wanted our power distribution system to be safe, to have adequate feeder and branch-circuit capacity, plus flexibility. General Electric switchgear gave us all these requirements."

E. L. MOLLOY, VICE PRESIDENT
MACY'S, SAN FRANCISCO

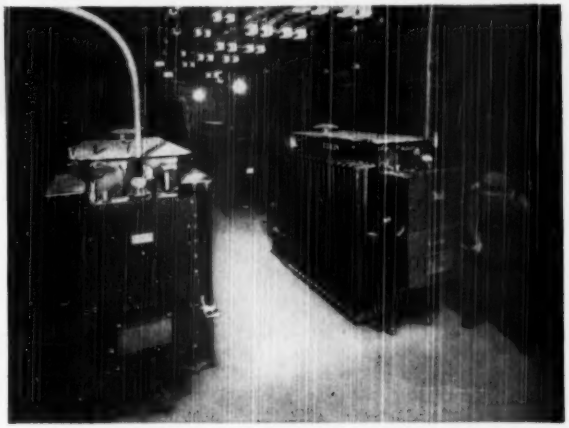

4-PG and E network trans. 500 KVA 12,000V 208Y/120V (GE)
Network protectors (GE)
To adjacent PG and E network vault
3 ACB's AL-2-100 4000 AMP
AL-2-50 AL-2-75 feeder breakers
Lighting feeders
Lighting feeders
Power feeders
Typical lighting bus riser 1600 amp, 3ϕ, 4 wire low reactance
To 3-200 KVA 208Y-480V trans. for elevators and escalators
Lighting panel
Bus tap
Lighting panel
Bus duct through 9 floors

One-line Diagram
Macy's San Francisco

This, the largest switchgear installation to date in any San Francisco commercial building, adequately handles the power requirements that average four watts per square foot (nearly 500,000 square feet). Flexibility of the feeder system permits load changes without increasing the load on the switchgear. The 4000-ampere breakers have induction relay tripping.

Macy's installation is a complete General Electric project—switchgear, three 200-kva transformers for elevators and escalators, power and lighting panels, motors, and control for ventilating and boiler-room auxiliaries. One source of responsibility plus the very best in co-ordinated planning, engineering, manufacturing, and service facilities to give maximum savings and efficiency to the customer.

G-E metal-enclosed switchgear handles the incoming 120/208-volt power. The equipment is divided into three sections, two for lighting, one for power. Breakers (cascaded) are of the drawout type for ease of inspection and maintenance.



Four G-E network units, rated 500 kva, 12,000-120/208 volts in a Pacific Gas and Electric Company vault serve the building. Macy's 2500-kva load represents one of the largest loads added to PG&E's downtown network in recent years.

low-voltage SWITCHGEAR

Modern industrial power distribution systems using G-E switchgear are applicable to any industrial plant or commercial building where you want proper voltage for top performance of equipment, an extremely flexible setup to take care of expanding or changing loads, adequate short circuit protection, safety to personnel, and low installation and maintenance costs.

Be sure to see the "More Power to America" full-color sound slidefilm "Modern Industrial Power Distribution." Ask your G-E sales representative to arrange a showing for your organization.

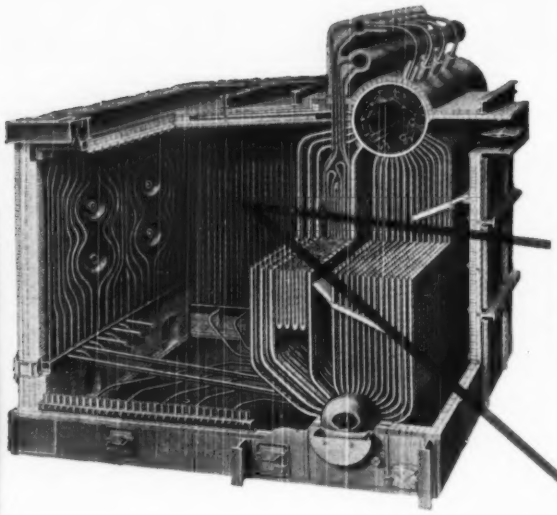
Investigate today the many advantages of using General Electric switchgear in your plant for efficient, flexible power distribution. Contact your G-E sales representative for further information—and write for the helpful bulletins listed below. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GEA-4966 Low-voltage Switchgear
GEA-3642 Air Circuit Breakers
GEA-2017 Network Protectors
GEA-3083 Metal-clad Switchgear
GEA-3592 Load-center Substations
GEA-3758 Load-center Distribution

GENERAL ELECTRIC

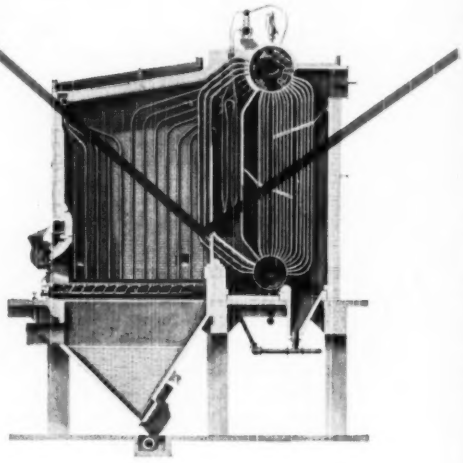
860-19

Which Vertical-Unit fits



Type VU-50
(for the higher capacity range)

This unit, the original VU design, may be fired by pulverized coal, oil or gas, or any combination of these fuels. Available for capacities up to 300,000, or more, lb of steam per hr, pressures up to 1000 psi and steam temperatures up to 900 F, or higher. Furnace bottom may be as shown or may be of hopper type. Economizer or air heater surface may be added.



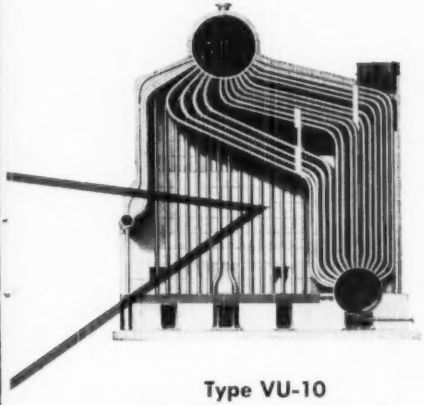
Type VU-30
(for the middle capacity range)

In this VU design, shown equipped with a C-E Spreader Stoker, the furnace proportions and arrangement of water wall surfaces may be adapted for firing by any type of mechanical stoker. Design is also adaptable for firing by oil or gas. Economizer or air heater surface may be added. Approximate capacity range 25,000 to 100,000, or more, lb per hr.

COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

boiler your special needs?



Type VU-10
(for the lower capacity range)

This member of the VU family is designed for industrial load conditions and particularly for plants having small operating and maintenance forces. Capacities range from about 10,000 to 60,000 lb per hr. Firing may be by spreader, underfeed or chain grate stokers, or by oil or gas burners. Any of these methods may be substituted for any other, should fuel market conditions make this desirable.

VU-10? VU-30? VU-50?

No matter what your combination of operating conditions, one of these three units can meet the particular requirements of your plant exactly. *Capacity?* The Vertical-Unit Boiler covers a complete range of capacities, from 10,000 lb per hour for smaller plants, up to 300,000 or more pounds per hour for larger industrial plants and utilities. *Pressures? Temperatures?* VU Units are available for steam pressures up to 1000 psi and temperatures up to 900 F, or more.

Or perhaps your *fuel requirements* are unusual. The VU-50 may be fired by pulverized coal, oil or gas, or any combination of these fuels. In the medium and lower capacity ranges the firing may be by any type of mechanical stoker as well as oil or gas. Moreover, any one of these methods may be substituted for another should a change in the fuel market occur.

This flexibility . . . this ability to meet the widely varying requirements of plants in virtually every branch of industry — at efficiencies ranging up to 88% — accounts for the wide acceptance of the Vertical-Unit Boiler. Throughout the United States and Canada, Latin America and abroad, the VU has been selected for installations with an aggregate capacity of well over 100,000,000 lb of steam per hour.

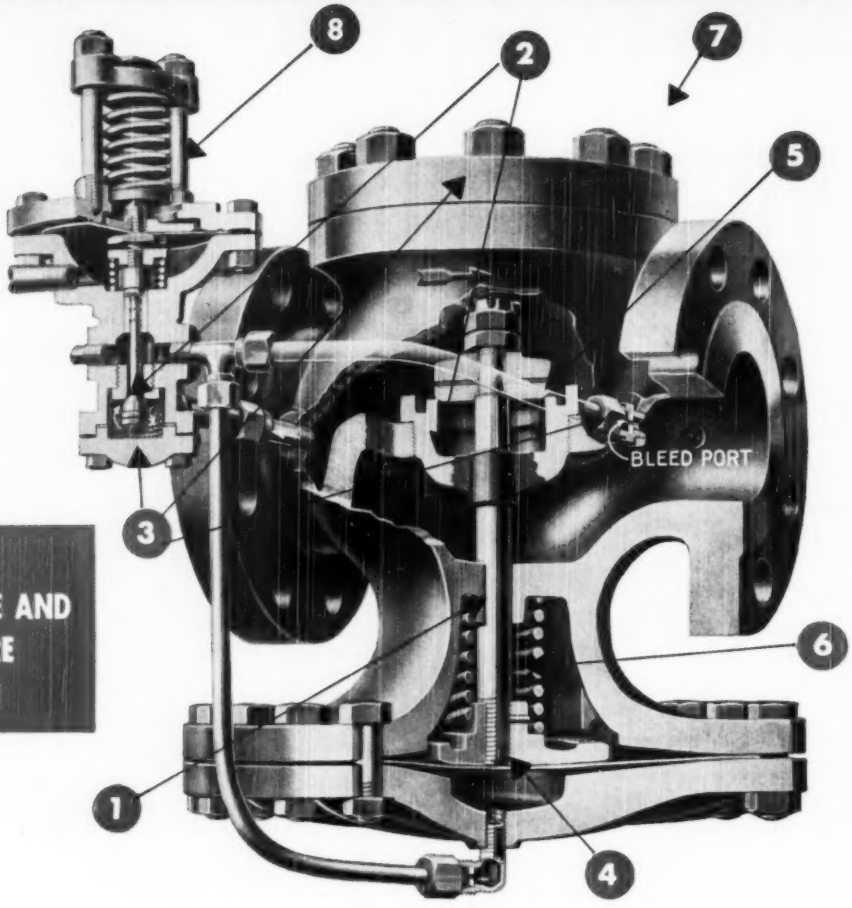
Whether you are considering the purchase of equipment for replacement or expansion, or for a new plant, a C-E Vertical-Unit Boiler will provide the right answer to your particular situation. We shall be pleased to supply catalogs and any additional information upon request.

B-392

— SUPERHEATER, INC.
200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

THESE SPENCE FEATURES *Reduce*



A TYPICAL SPENCE PRESSURE AND TEMPERATURE REGULATOR

LESS DOWN-TIME of the system! Less time and money wasted on replacement of parts! Thousands of installations throughout the country have proved that Spence Self-Operated Regulators stay "on the line" . . . provide *dependable, trouble-free* pressure and temperature control. Users know these precision-engineered Spence units rarely need extensive repairs or special attention. Here are a few of the Spence design features that help keep *maintenance at a minimum:*

1 **PACKLESS CONSTRUCTION**—All Spence main valves and most pilots are built without stuffing boxes. This packless construction saves many maintenance man-hours because it eliminates the need for closely fitted parts which may stick or bind due to uneven expansion or foreign matter.

2 **EASY TO CLEAN**—The seat and disc of the main valve and pilot can be cleaned and any working part removed *without taking the main valve out of the line.*

3 **NO DISMANTLING FOR INSPECTION**—Special openings are provided to inspect the main valve disc, the pilot valve member and the SECO Metal bleedport. Inspection is easier, too, because the pilot is not an integral part of the main valve. The pilot is protected by an accessible built-in strainer.

4 **LONG-LIFE METAL DIAPHRAGMS**—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

SPENCE PRESSURE *and* TEMPERATURE

Maintenance...Cut Costs

BUILT TO LAST FOR YEARS!

That's the reason Spence Self-Operated Regulators lower over-all costs. Dollar for dollar, you can count on quality performance for a longer period of time. Look at three of many Spence features that assure long regulator life:

5 DURABLE SECO METAL SEATS AND DISCS—Spence seats and discs are made of durable SECO Metal which resists wiredrawing. *More than twenty years of experience* with SECO Metal in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

6 SPRING OUT OF PATH OF STEAM—The spring in the Spence Regulator is out of the path of high-pressure steam or other fluids flowing through the valve. Since the spring operates at low unit stress, it has exceptionally long life.

7 LESS FRICTION—All Spence Regulators are built with *packless* main valves which are actuated by large, balanced diaphragms. This design minimizes friction. Valves remain unaffected by changes in service conditions or length of service.

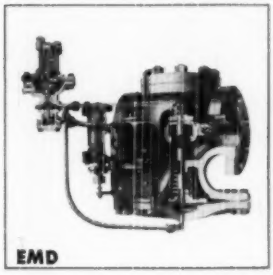
WHY SPENCE UNITS REGULATE ACCURATELY

8 YOU CAN BE SURE of accurate regulation because *sensitive* pressure or temperature pilots control the main valve of every Spence unit. This unique design enables the Spence Regulator to serve many functions and handle all the various types of fluids under a wide range of conditions.

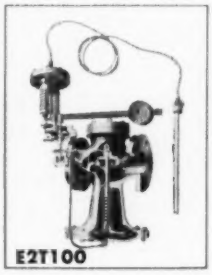
One of the great advantages of this Spence design is the interchangeability of all pilots on all sizes of main valves. Any main valve can be changed from a pressure to a temperature regulator or vice versa *simply by substituting one type of pilot for another.*

WIDE RANGE OF SIZES

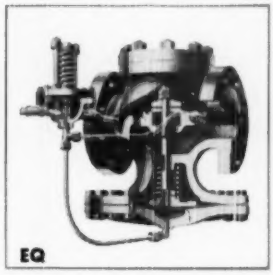
Spence Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* With minor adjustments, any Spence Regulator can be easily switched from one service to another.



EMD



E2T100



EQ

The Type **EMD** Pressure Regulator includes a SPENCE Solenoid Pilot to cut it on and off electrically. • The Type **E2T100** Temperature Regulator in effect is a pressure regulator which is constantly reset by small variations in temperature at the sensitive thermostat. • The Type **EQ** Back Pressure Regulator is a self-operated, packless unit which controls its own initial pressure. The general construction is the same as the Type ED Pressure Regulator.

FREE BULLETIN GIVES ALL THE FACTS

YOU WILL FIND complete engineering details and selection data on Spence Regulators in free bulletin No. 5000. It features a *full color, fully illustrated description of the operating cycle* of a Spence Regulator. Send for your copy of this valuable bulletin today.

SPENCE ENGINEERING COMPANY, INC.
WALDEN, NEW YORK

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Tennessee Coal, Iron and Railroad Company

The Springs Cotton Mills

Ford Motor Company

Cochrane Corporation

Philadelphia Electric Company

Pennsylvania Power & Light Company

L. H. Gilmer Company Div. of United States Rubber Co.

York Corporation

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The Atlantic Refining Company

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Ohio Edison Company

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Spence

REGULATORS

Is your air-conditioning equipment

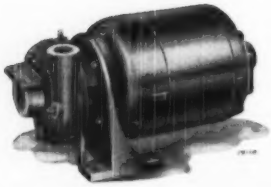
OVERLOADED with EXCESS H. P.?

Here's how you can cut first cost and power costs by specifying smaller, more efficient *I-R Motorpumps.*

Today, more than ever before, users of air conditioning equipment are looking for ways to *save*—not only on initial investment, but on operating costs as well. And they certainly don't want to pay for more horsepower than they need.

Take the pumps, for example. Why use a pump that requires a 2 h.p. motor when a 1½ h.p. I-R Motorpump may do the same job at so much lower cost? The higher efficiency and non-overloading characteristics of I-R Motorpumps permit you to cut your costs—and perhaps reduce the size and weight of your equipment as well. Their outstanding record for dependability under all types of operating conditions means more satisfied users—and more repeat orders.

Call your local I-R pump distributor or nearest Ingersoll-Rand branch office and have an experienced pump engineer show you how to save yourself *and* your customers money by using I-R Motorpumps engineered for the job. Prompt shipment from stock.



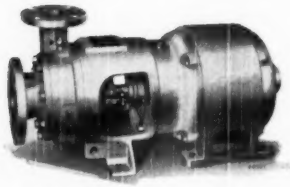
I-R MOTORPUMPS — Class KRVS

Single Stage, 5 to 125 gpm. Heads to 100 ft.

Suitable for 3, 5, and 7½ package units

These compact, high-efficiency, fractional hp Motorpumps require no special foundations, and may be mounted vertically, horizontally, or at any angle, provided the motor is not below the pump.

No drip pan is needed. A fool-proof mechanical shaft seal eliminates stuffing box leakage and requires little attention and maintenance.



I-R MOTORPUMPS — Class RV

Single Stage, 20 to 275 gpm. Heads to 500 ft.

For larger package units and engineered installations

These heavy-duty, completely self-contained units provide maximum efficiency for integral hp applications.

Features include—flexibility of mounting, ball-bearing-mounted oversize shaft, mechanically and hydraulically balanced impeller, and extra deep stuffing box which is easily accessible for packing.

THE CAMERON MOTOR PUMP
A PRODUCT OF

Ingersoll-Rand
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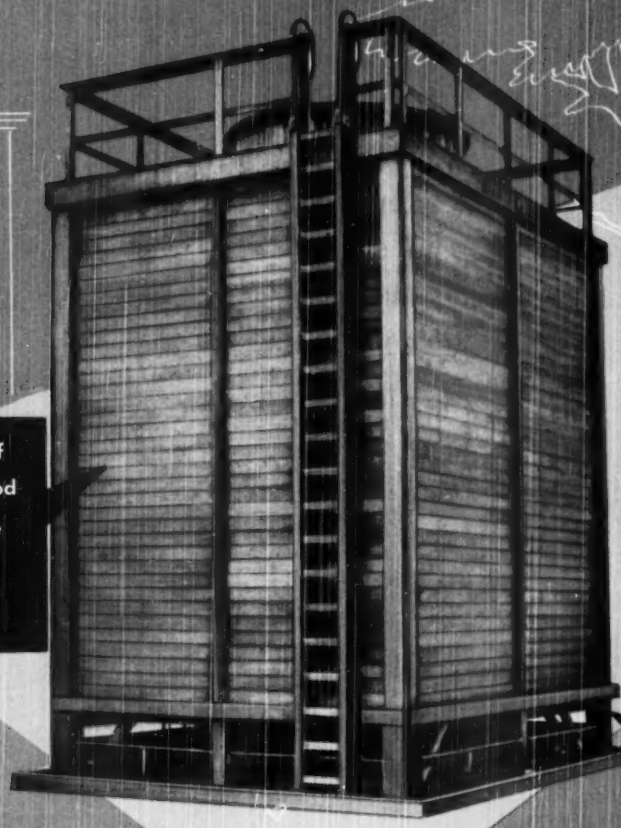
COMPRESSORS · AIR TOOLS · ROCK DRILLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL AND GAS ENGINES

water supply limited?

a FOSTER WHEELER "package" cooling tower supplies the need—



CASING of
Redwood
Transite
Metal
or
Brick

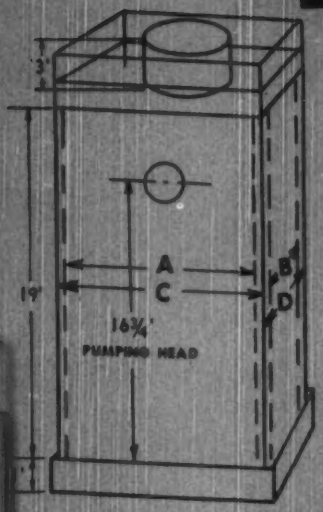
STRUCTURE of
Redwood
or
Steelwork

Do you have a water cooling problem? If it is your office building, department store, chemical plant or any other type of industrial establishment or institution, Foster Wheeler offers a "Package" Cooling Tower which can reduce your present cooling water consumption to a mere 2%.

FOSTER WHEELER

Principal dimensions of standard package cooling towers

for capacities from 75 to 750 gpm



A	B	C	D
6	6	7	7
8	8	9	9
8	12	9	13
12	12	13	13
12	16	13	17

Height of all towers 19' from basin curb.
Fixed static pumping head 16¾'.
Fan ring and railing height 3'.

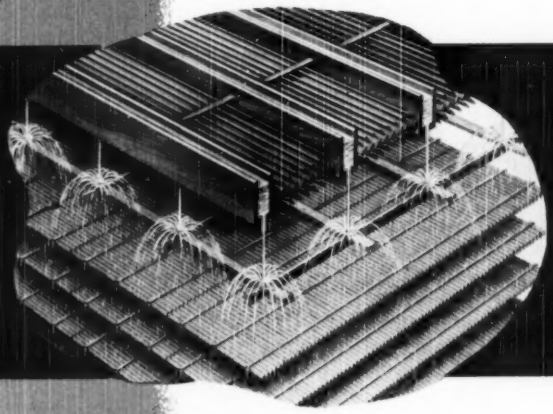
GRAVITY DISTRIBUTION SYSTEM

•

NO SPRAY NOZZLES TO CLOG

•

REMOVABLE FILL RACKS



ADJUSTABLE PITCH FAN BLADES

•

STRUCTURE DESIGNED FOR 100 MPH WIND

•

QUIET OPERATION

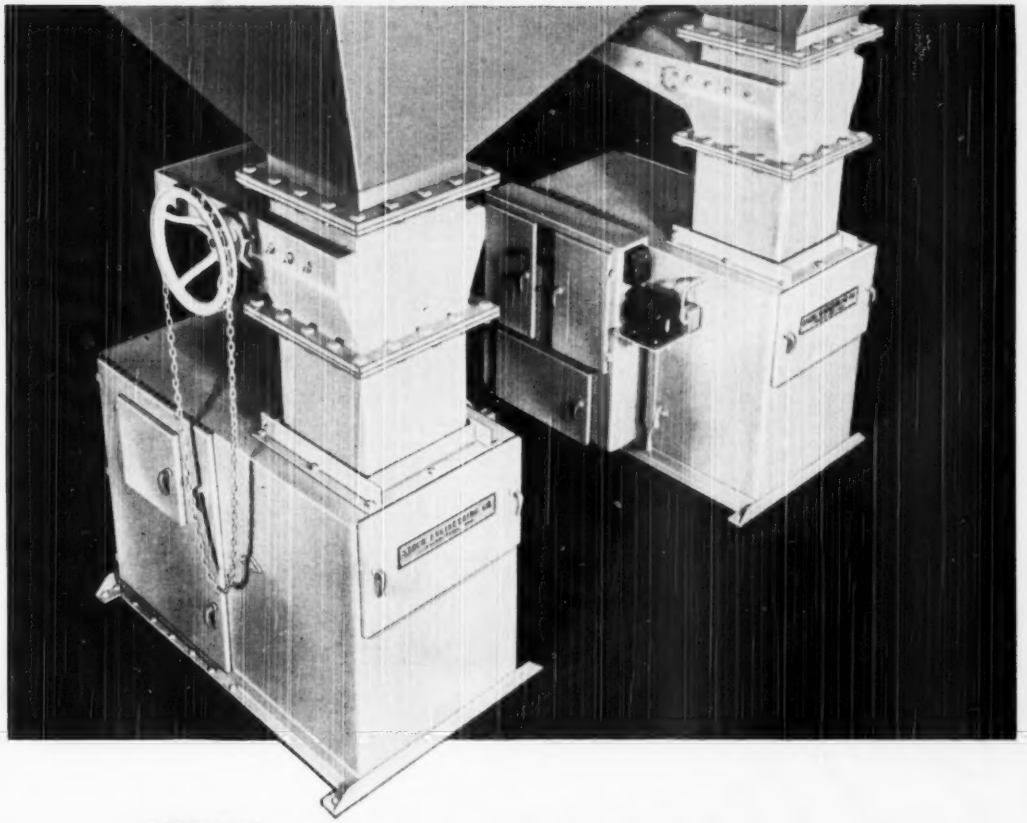
A variety of structural and casing materials is available to meet your particular requirements.

Your best guarantee for a constant supply of cooling water for air conditioning, processing, or other uses, is a Foster Wheeler Cooling Tower. Regardless of size, the same engineering "know how", the same attention to detail and the same quality of materials go into every installation.

For further information, write to:

FOSTER WHEELER CORPORATION

165 Broadway New York 6, New York



STOCK ENGINEERING COMPANY

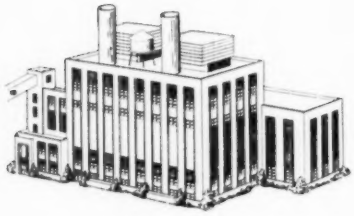
Announces

that we have incorporated our company so that we may continue to grow and to serve our customers better. This change in status will in no way affect the management of the company or its policy to furnish the highest quality design and workmanship in its S-E-Co. Coal Scales, S-E-Co. Coal Valves, and CONICAL Non-Segregating Coal Distributors.

In order to conform with the wishes of the professional engineers who object to the use of the word "engineering" in the title of a corporation, we have changed our name to STOCK EQUIPMENT COMPANY.

We are looking forward to serving you as we have in the past.

STOCK EQUIPMENT COMPANY
715P Hanna Building ★ Cleveland 15, Ohio

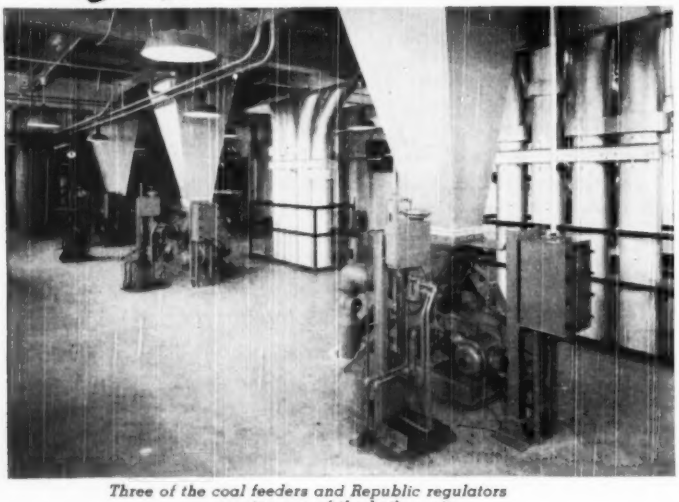


● at the New GADSDEN

Steam Plant of the

Alabama Power Company

Efficiency HAS BEEN



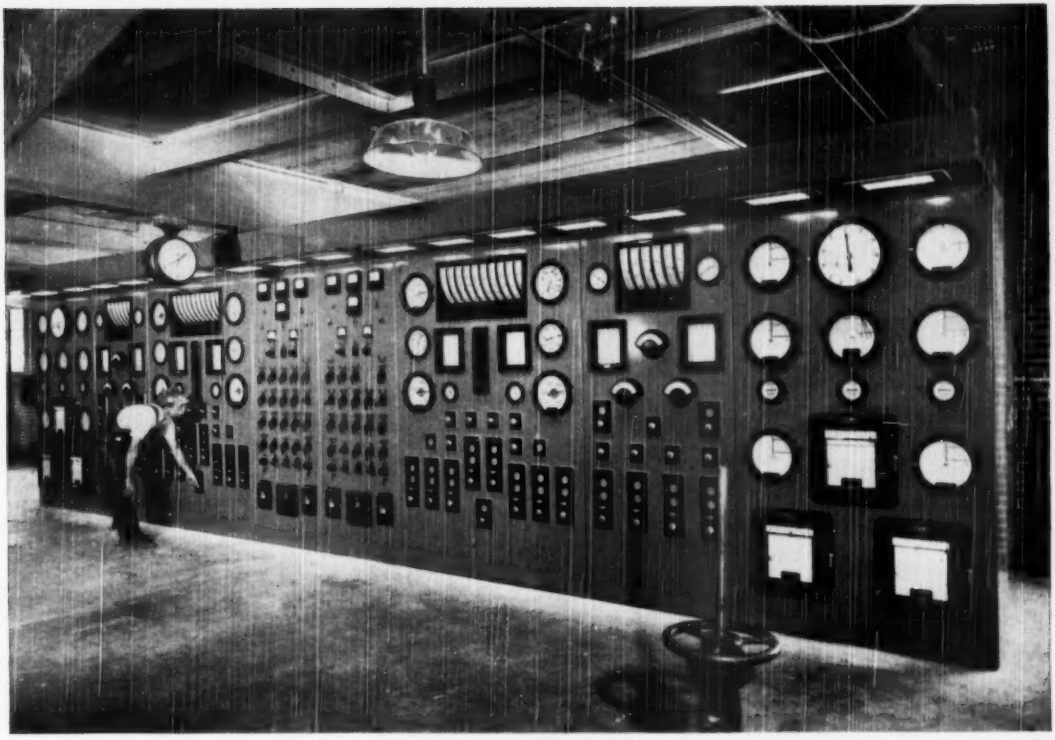
Three of the coal feeders and Republic regulators serving one of the boiler units.

It is the policy of Alabama Power Company to generate, transmit and distribute electricity to its customers at the lowest cost consistent with good service.

When designing the new 120,000 kw. Gadsden Steam Plant, the Alabama Power Company, in keeping with this policy, incorporated proven engineering developments which contribute to economical power generation. High among these was REPUBLIC automatic boiler control.

Two steam generators, each with a capacity of 600,000 pounds of steam per hour, and operated at 875 psig. and 885°F, supply steam to the two turbines. Fuels used are natural gas or pulverized coal, either singly, or in combinations.

The REPUBLIC control board is



On this Republic control board are mounted all gauges, meters and controls for operating each of the two boilers and their auxiliaries.

MADE *Automatic*

made up of one electrical panel, one recorder panel, and two combustion control panels per boiler. All panels are joined together to form one continuous board for the two boilers. The boilers are rubber mounted to reduce vibration, are gray in color, and lighted from an overhead canopy.

The REPUBLIC combustion control system receives its initial impulse from the main steam line through the master controller which establishes a pneumatic loading pressure proportional to the boiler load. The loading pressure is transmitted to the variable speed coal feeders, and to the gas flow valve when burning gas in combination with coal. This pressure is also transmitted to the air flow regulator. A corrector regulator provides means for maintaining the proper steam flow air flow relationship. Provision has also been made for manually adjusting this ratio from the boiler panel.

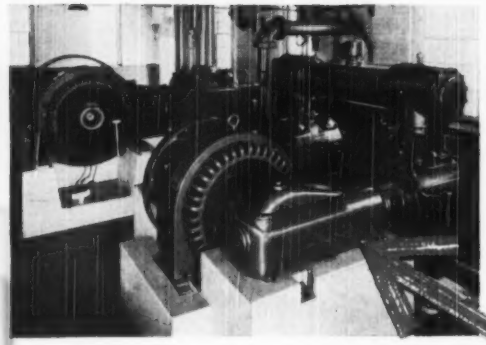
Air flow and furnace pressure are regulated by hydraulic coupling speed, but fan damper controls are provided for use at extremely low loads, when the fan speed would be reduced below 30% of the motor drive speed.

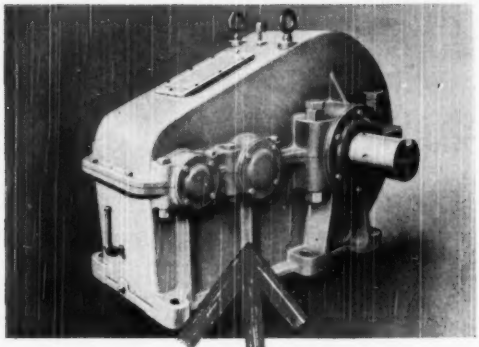
The boiler feedwater pumps are equipped with REPUBLIC automatic minimum flow hand reset valves. These valves open when the flow through the pumps is 150 gpm or less and by-pass this amount of water to the deaerating heater.

The REPUBLIC feedwater regulator is located on the operating floor and can be manually operated during emergencies from the boiler control panel. The valve control is pneumatic, single element, but the valve is operated by a hydraulic cylinder.

For complete information on REPUBLIC automatic boiler control write for Data Book No. S-21.

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS





For the best lubrication use SINCLAIR RUBILENE

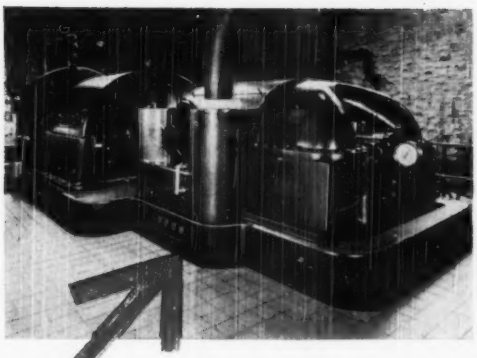
Over many years engineers in power plants throughout the country have accepted Sinclair's Rubilene as the finest available lubricant for power house equipment.

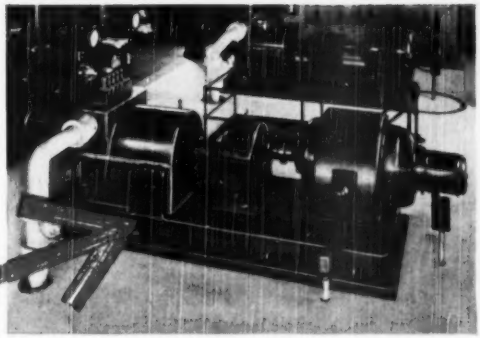
Sinclair Rubilene has always been a top-quality oil, as it has been constantly improved through the years, incorporating the latest technological developments in refining and processing. It resists oxidation under continuous high temperatures, and recirculation. It separates rapidly from water and is non-foaming. Through long periods of use it retains its original qualities, providing uniform, trouble-free lubrication and low maintenance costs.

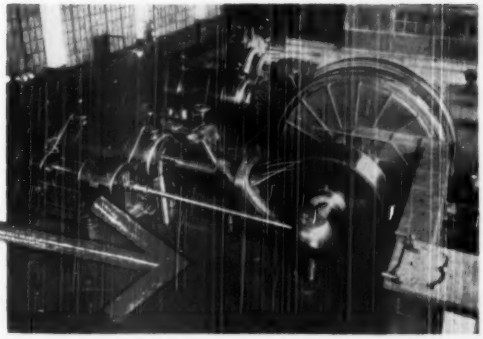
Yes...Rubilene's finer quality pays dividends in the power plant.

SINCLAIR

For lubrication counsel . . . see your nearest







REFINING COMPANY

Supplier of Sinclair Products or write to Sinclair Refining Company, 630 Fifth Ave., New York 20, N. Y.

Read how this

DETROIT ROTOSTOKER

fulfilled these

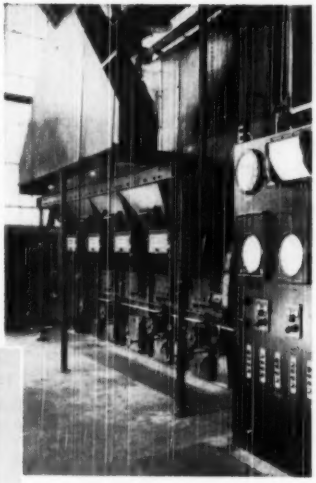
ECONOMY REQUIREMENTS

1 Continuous capacity.
2 Ability to handle wide range of coals.
3 High efficiency.
4 Ability to handle fluctuating loads.
5 Minimum labor.
6 Compact arrangement.

Modern Boiler Unit Serves Hanes Dye and Finishing Company Winston-Salem, N. C.

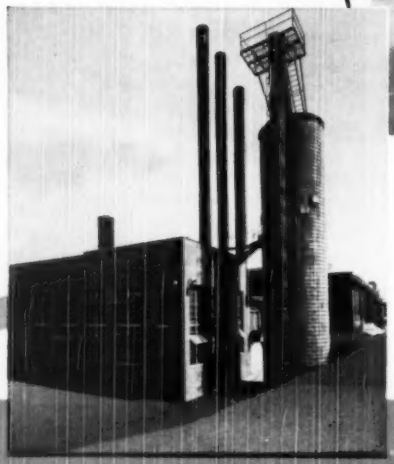
High efficiency Single Unit Boiler handles wide load swings, provides increased capacity, and saves 20% in fuel in a North Carolina plant.

By Ralph P. Hanes, President and W. O. Sprinkle, Plant Engineer



Detroit RotoStoker Power Dumping Type in the Hanes Dye and Finishing Company Boiler Plant.

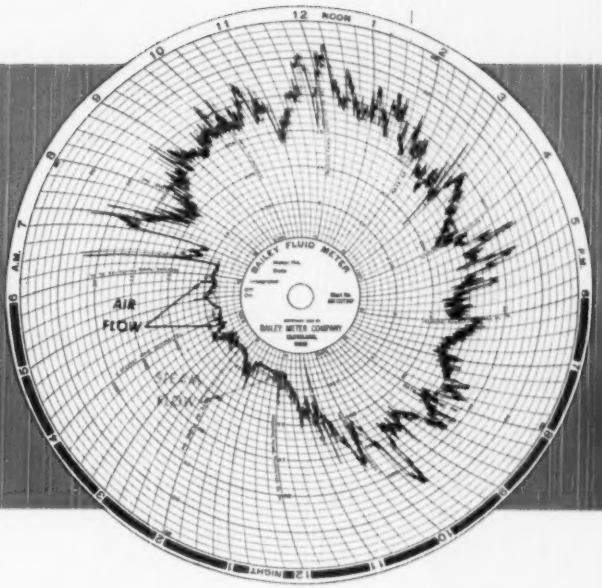
Send for This Article



DETROIT SINCE 1898 STOKERS

Talk About Range

Typical 24 hour steam flow—air flow chart from Hanes plant. RotoStoker handles wide range of load fluctuations.



Hanes Dye & Finishing Co.
Winston-Salem, N. C.

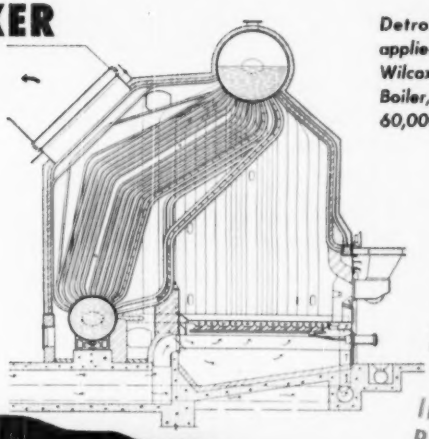
gets results with

DETROIT ROTOSTOKER

With a modern boiler Detroit RotoStoker accomplishes a three-fold saving: Fuel saving was 20%; steaming capacity was increased 20% to a 60,000 lb. per hour maximum; the new generating unit occupies 37% less space than four old boilers it replaced.

Detroit RotoStoker follows load fluctuations of 12 to 1, in a 24 hour period, interspersed with sudden swings over a wide range, with close automatic control of pressure as a routine operation.

The Detroit RotoStoker is a money saver. Write for copy of the Hanes Story.



Detroit RotoStoker—applied to Babcock and Wilcox Integral Furnace Boiler, capacity up to 60,000 pounds of steam.

Other Types and Sizes of DETROIT STOKERS for Every Industrial or Power Need

DETROIT STOKER COMPANY

GENERAL MOTORS BUILDING, DETROIT 2, MICHIGAN
District Offices in Principal Cities
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CONVEYORS
COMPANY INC

for power equipment?

All these catalogs of power generating equipment manufacturers are instantly available in Section No. 1 of your Sweet's File for Power Plants.

The other sections of this Sweet's File contain additional catalogs covering a wide range of materials and equipment—useful and up-to-date information on product forms, characteristics, performance and use.

This grouping of manufacturers' catalogs, in sections according to products or use of products, is made for your convenience, so that you can more readily compare one product with another. Indexes of manufacturers, products and trade names lead you quickly and easily to the catalogs you are looking for.

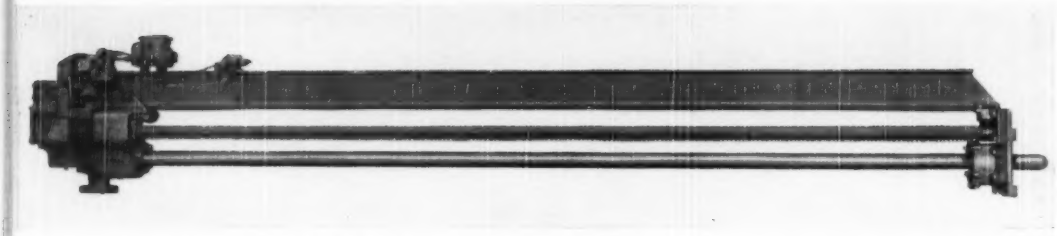
Sweet's is working constantly to get more manufacturers to send you their catalogs in this easy-to-use form. If you fail to find what you want, please tell us.

Sweet's catalog service

DIVISION OF F. W. DODGE CORPORATION • 119 WEST 40TH STREET • NEW YORK 18, N. Y.

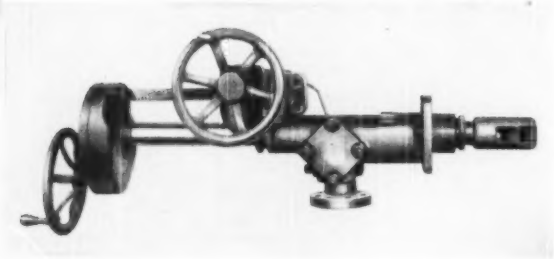
The "LONG" and *Better Boiler Cleaning*

Here's the LONG of it



Vulcan T-2 Long Retractable Blower, for travels up to 25 feet, is ideal for hard-to-clean surfaces. Lance shown retracted (not in action) for protection against high furnace temperatures, thus cutting maintenance costs. Operated by push button at unit or at central control panel. Install at any angle, indoors or outdoors.

Here's the SHORT of it



Manually-operated Vulcan HG-1 Gun Type Blower, 12- or 24-inch travel, blasts hard-to-clean deposits from boiler, water wall and superheater surfaces. Air or steam. Easy to operate. Practically no maintenance costs. For automatic operation, use Vulcan RW-1.

VULCAN *Automatic*

the "$HORT" of ---at Lower Cost--

Is your soot blower maintenance too high? Is it costing you too much to keep your boilers clean? Then it's time to call in a Vulcan engineer to study your problem. Chances are he'll help you find ways to cut maintenance and cleaning costs materially. His survey will cost you nothing—and could save you a lot of money. No obligation. Just mail the coupon—NOW.

VULCAN SOOT BLOWER DIVISION

Continental Foundry & Machine Company
DUBOIS, PENNSYLVANIA

Mail this Coupon TODAY

VULCAN SOOT BLOWER DIVISION
DUBOIS, PENNSYLVANIA

Without obligation to me, please send your engineer to survey our soot blowing equipment and show us how we might cut our boiler cleaning costs.

NAME .....

POSITION .....

COMPANY .....

STREET ADDRESS .....

CITY ..... STATE .....

YOU'LL SAVE MONEY WITH A SPREADER

YOU'LL SAVE EVEN MORE WITH A . . .

View of a recent Perfect Spread Stoker installation consisting of four traveling grate spread stokers, 10' wide x 14'3" long. They are installed under Wickes four drum bent tube boilers and have a continuous capacity of 60,000 lbs. per hour. Consulting Engineers were Albert Kahn, Associates.

Only Perfect Spread Stoker assures even coal distribution . . . won't clog on wet coal . . . has a cinder return system that works . . . adjustable overfire air

THERE'S NO GUESSWORK about it. You'll save real money – important sums regularly – with a spreader stoker. It enables you to burn a wide range of coals, including the cheaper, high ash coals, with top efficiency. No more paying premiums for coal when you have a spreader stoker. You utilize the coals that are attractively priced in your locality.

IN SPREADER STOKERS—IT'S PERFECT SPREAD —FOR MOST STEAM AT LEAST COST

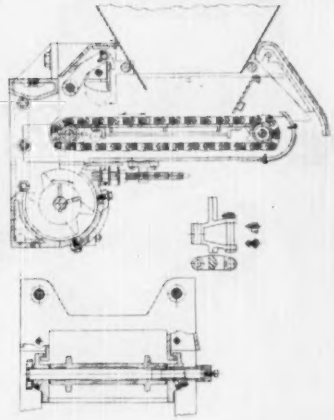
Exclusive features, unique in design, make the Perfect Spread Stoker the most efficient spreader that has ever been built. First and foremost, its feeder assures positive, continuous and accurate coal feed . . . it won't clog even when coal is wet. Next, the spiral overthrow rotor is unmatched for *even* coal distribution. And the engineered cinder reinjection and adjustable overfire air system are final assurance of superior fuel combustion.

Perfect Spread Stokers are made in both continuous discharge, dumping and stationary grate types. Coal feed is adjustable from 50 lbs. to 7,500 lbs. of coal an hour per feeder. Capacities range from 8,000 to 500,000 lbs. of steam per hour. Mail coupon on next page for full information . . . and be sure to call in your Consulting Engineer for recommendations regarding your requirements.

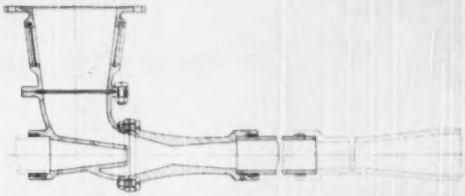
STOKER *BUT*....

PERFECT SPREAD STOKER

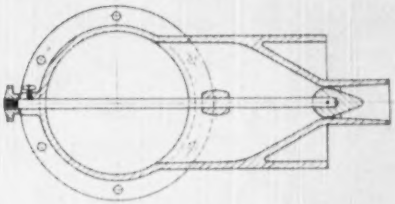
AMERICAN
ENGINEERING COMPANY



NON-CLOGGING CONVEYOR FEEDER: Coal enters feeder from hopper, and is conveyed positively, continuously and uniformly forward. Coal is not fed in slugs.



ENGINEERED CINDER REINJECTION SYSTEM: An extremely efficient system; all fittings of alloy iron. Air driven through the venturi section sucks cinders into the air stream for return to the furnace. A *separate* line is provided for each cinder drain point.

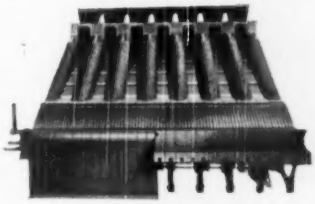


ADJUSTABLE OVERFIRE AIR SYSTEM: Most of the overfire air enters furnace through nozzles in side or rear walls. Each nozzle is a separate venturi-type unit and *individually* adjustable.

WHERE UNDERFEED STOKERS ARE INDICATED YOU CAN'T BEAT THE TAYLOR STOKER

Taylor Underfeed Stokers of adequate grate area deliver over 90% of the ash to the ashpit . . . and most of the remainder is collected in boiler passes without expensive dust recovery equipment.

Shown at right is a 7-Retort, 25 Tuyere Taylor Stoker. It provides low-cost steam for plants of moderate size. The principles of combustion are identical with those of the high capacity Taylor Stokers that are the standard for central stations and large industrial plants.



AE

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PENNA.

Other AE Products are Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Car Shakers, Car Pullers.

American Engineering Company
2400 Aramingo Ave., Philadelphia 25, Pa.

Gentlemen: We are interested in "most steam at least cost."
Send me full information about ____ Perfect Spread Stokers;
____ Taylor Stokers.

Name _____ Title _____

Company _____

Address _____

City _____ Zone ____ State _____

How much should a valve cost?

Fig. 560—200-pound Bronze Regrinding Horizontal Swing Check Valve with screwed ends, screwed-on cap and regrindable, renewable bronze disc.

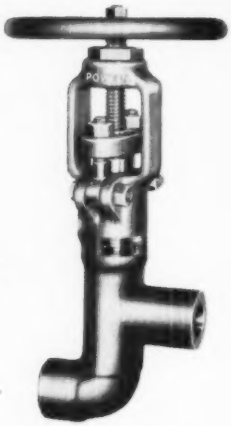


Fig. 1331-A — Class 1500-pound Steel Integral Bonnet Offset Globe Valve with welding ends. Also available in "Y" and Angle patterns.

Fig. 375—200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable wear-resisting "Powellium" nickel-bronze disc.

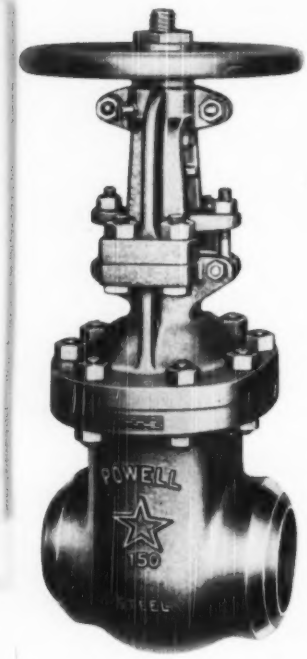


Fig. 1503 W. E.—Class 150-pound Cast Steel Gate Valve with welding ends, outside screw rising stem, bolted flanged yoke and tapered solid wedge.

Fig. 559—125-pound Iron Body Bronze Mounted Swing Check Valve with flanged ends, bolted flanged cap and regrindable, renewable bronze seat and disc. Disc, when wide open, permits full, unobstructed flow through valve body.

Fig. 1793 — Large 125-pound Iron Body Bronze Mounted Gate Valve. Sizes 2" to 30", incl. Has outside screw rising stem, bolted flanged yoke and tapered solid wedge.

POWELL

Only as much as is necessary for it to meet all the conditions under which it must operate.

When the service in which a valve is to be used requires special design and materials, it is poor economy to try to make an inexpensive valve do the job. "Down time", maintenance costs, if not actual valve failure, will far more than offset any initial saving.

On the other hand, in a majority of services, standard Powell Valves satisfy all requirements for long, trouble-free performance.

And, because Powell makes all kinds*, it is the soundest economy to standardize on Powell Valves for all your flow control requirements.

Fig. 241 — Large 125-pound Iron Body Bronze Mounted Globe Valve. Made in sizes 2" to 16", incl. Has outside screw rising stem, bolted flanged yoke and regrindable, renewable bronze seat and disc.

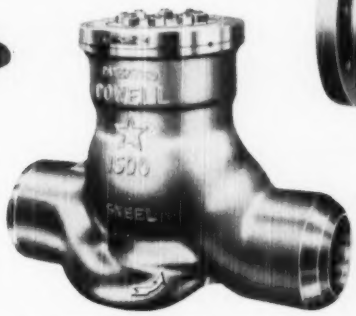


Fig. 11365 W.E.—Class 1500-pound Cast Steel Pressure Seal, Piston - guided, Horizontal Lift Check Valve, with welding ends. Streamline design permits maximum flow through valve with minimum pressure drop.

Fig. 1708—200-pound Bronze Globe Valve with screwed ends, union bonnet, renewable, specially heat treated stainless steel seat and regrindable, renewable, wear-resisting "Powellium nickel-bronze disc.

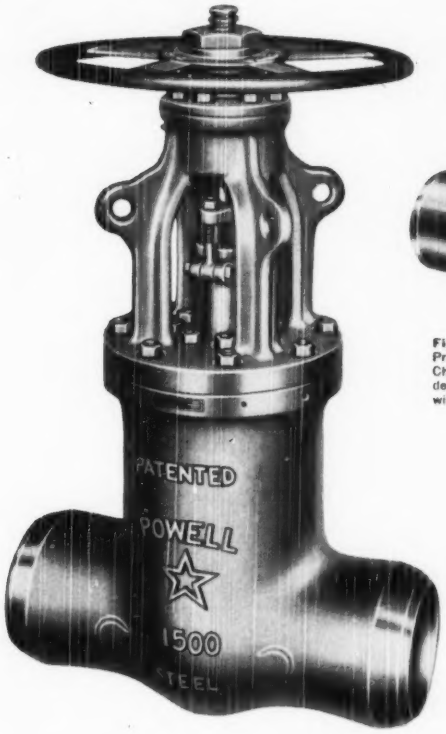


Fig. 11303 W. E.—Class 1500 Cast Alloy Steel Pressure Seal Gate Valve with welding ends.

***The Complete Powell Line includes Globe, Angle, "Y", Gate, Check, Non-return, Relief and Flush Bottom Tank Valves in Bronze, Iron, Steel and a wide range of Corrosion-resistant metals and alloys.**

Ask your nearest Distributor—or write direct

The Wm. Powell Company, Cincinnati 22, Ohio

DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

VALVES

How would you hold temperatures in this viscous line?

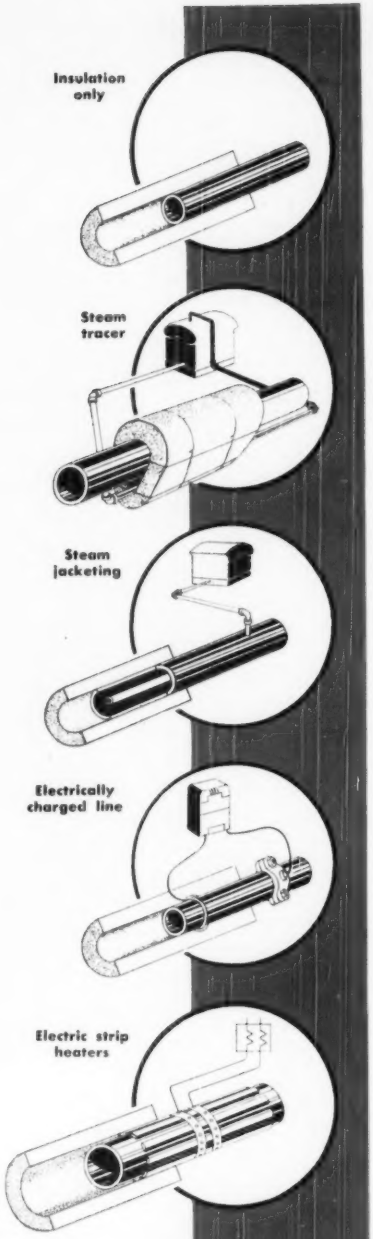
- Suppose a three-inch pipe carries asphalt 1,000 feet from storage tank to process. The asphalt starts in highly fluid state at 450° F. Flow would be seriously retarded below 435° F. What's the best way to maintain adequate temperature over entire distance?

Here's what the Armstrong Engineer recommended:

All methods shown here are effective within their own limitations. However, the line charged with low-voltage electricity is most practical for the long run and critical temperature given here. This, like all the other methods, requires normal insulation of the line, in addition to the heating devices, for greatest economy.

Insulation by itself would permit too great a heat loss. Also, there is always the possibility, even in a continuous process, of occasional shutdowns which could leave the lines completely clogged. Strip heaters are better adapted to short runs and localized applications. Jacketed lines are high in first cost but low in cost of operation. They work best when the inner line is of small diameter. Steam-traced lines are excellent where steam is readily available and considerable variation in temperature can be tolerated.

The complete contract service offered by Armstrong is primarily set up to furnish insulation materials, the engineering know-how for their correct application, and carefully supervised workmanship in their erection. But when a problem arises that's allied to insulation, as this one is, the wide experience of Armstrong's engineers is at your service. That's why it pays to call in an Armstrong man when you're planning your thermal installations, hot or cold. He can often save you money. Just phone the nearest Armstrong office or write direct to Armstrong Cork Company, 7004 Maple Avenue, Lancaster, Pennsylvania.



ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS (A) INSTALLATION

FOR ALL TEMPERATURES FROM 300° F. BELOW ZERO TO 2800° F.

TRI CLAD MOTORS
REG. U.S. PAT. OFF.
will run safely without relubrication for as long as any general-purpose motor you can buy—
and if the application makes relubrication a must, you can grease a TRI CLAD without halting production
GENERAL ELECTRIC
HERE'S WHY

TRI CLAD MOTORS will run safely without relubrication for as long as any general-purpose motor you can buy—

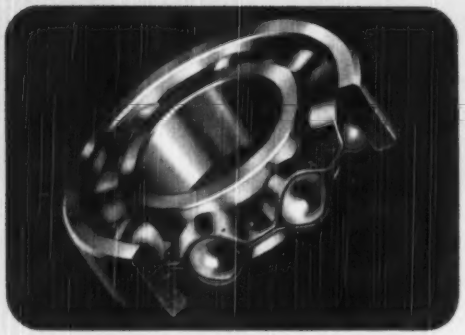
Tri-Clad extra lubrication "protection" can save you money because:

1. Tri-Clad's oversize grease reservoir and the heaviest standard-service bearings mean you do not have to bother with greasing between motor check-ups.

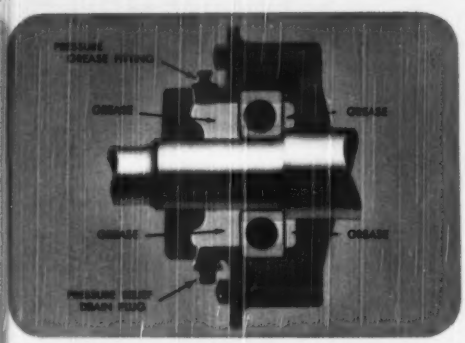
2. When relubrication is needed on those tough applications, you can grease a Tri-Clad without interrupting production-line operations.

Tri-Clads are grease-gun easy to lubricate *on the job*. Moreover, a Tri-Clad motor will run safely where an ordinary motor would fail. Chances are you'll be spared the cost of a "special" motor.

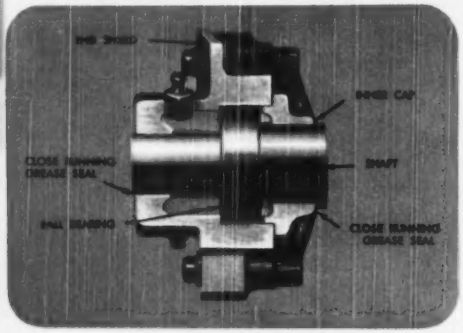
YOU BE THE JUDGE! The best way to prove to yourself that Tri-Clad gives you the most for your motor dollar is to contact your local G-E office. Tri-Clad stocks are complete. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*



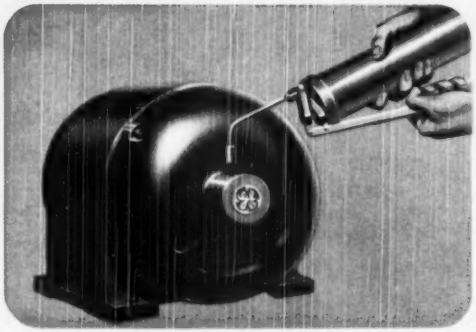
1 **EXTRA BEARING PROTECTION** — Tri-Clad gives you extra bearing protection because heaviest standard-service bearings are carefully selected to withstand severe loads for long periods.



2 **EXTRA GREASE** — Four times the ordinary amount of grease is packed into the large Tri-Clad grease reservoir. Since bearing life depends on grease, this means that Tri-Clad motors will run safely for years — for as long as any general-purpose motor you can buy.



3 **SEALED-IN BEARINGS** — Bearings and grease are completely sealed in a cast housing with *long* running seals for extra protection from dirt, dust, and lubricant leakage.



4 **PRESSURE-RELIEF GREASING** — An efficient system of pressure-relief lubrication (with standard fittings) enables a Tri-Clad motor to be quickly and easily greased on the job when and if it's needed.

GENERAL ELECTRIC

HIGH DIFFERENTIALS
ARE NO PROBLEM
with HAGAN
Ring Balance Meters

With ordinary meters, high differential pressures present serious difficulties—but not with the Hagan Ring Balance Meter.

Hagan meters for differentials up to 420 inches of water require exactly the same size case as low-differential meters. There is no drop leg, no U tube—everything is inside the case.

With both high-differential and low-differential Hagan Ring Balance Meters, checking and calibration are done by the same simple method, using a set of check weights which are furnished with the meter. The water column method, which is especially cumbersome when high differentials are involved, is unnecessary, and it offers no routine advantages over the check weight method.

For full information on Hagan Ring Balance Meters, fill in the coupon below or write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pennsylvania.

HAGAN CORPORATION

RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
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Please send me further information on Hagan Ring Balance Meters. I am particularly interested in.....

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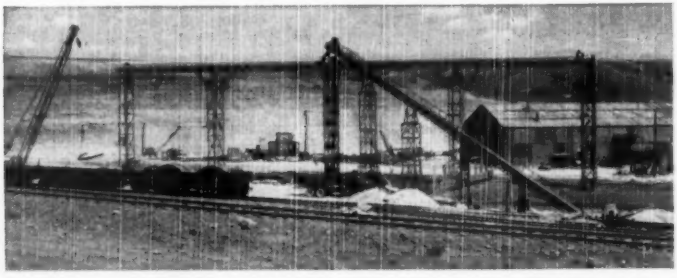
P2

For heavy-duty conveyors . . .

IT'S TIMKEN®...

Over the years, the advantages of Timken® tapered roller bearings for conveyor belt idlers have been proved time and time again. Almost every heavy duty conveyor has relied on Timken bearings for long life and dependable, low-cost operation. This Atlas conveyor installation is only one of the thousands all over the country that roll on Timken bearing equipped idlers.

AND TIMKEN...



Recent conveyor job using Timken-equipped idlers is this Pioneer conveyor used in the Fort Randall Dam and Reservoir Project at Pickstown, South Dakota. There are 1315 feet of conveyor, 260 idlers, and 1560 Timken bearings. The installation was made in 1949. Timken bearings prevent breakdowns on the job. Keep lubricant in—dirt and moisture out. Provide maximum capacity for radial and thrust loads.

AND TIMKEN AGAIN!

And here's another new one that's Timken-equipped—a Stephens-Adamson belt conveyor in a large eastern central power station. Today, as well as for the past 25 years, Timken bearings are first choice for the tough conveyor jobs. There's no other bearing with so much to offer . . . no other bearing so fully proved! The Timken Roller Bearing Company, Canton 6, Ohio. Cable address: "TIMROSCO".

Wherever the going's tough industry turns to

TIMKEN

TAPERED ROLLER BEARINGS

Typical application of Timken bearings for conveyor idlers.

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST ◫ LOADS OR ANY COMBINATION ◫

IT'S WHAT YOU DON'T SEE THAT Cripples POWER PLANTS!

You run the risk of lowered efficiency — even plant shutdown — when you fail to protect your power generation equipment against attacks of scale, embrittlement, carry-over and corrosion! The following Allis-Chalmers corrective chemicals, recommended and applied by specialized water-conditioning engineers, are available to solve all of *your* costly water and steam troubles.

AKON TREATMENT — An effective oxygen absorbent and sludge coagulant for boilers, either internally or externally treated.

AKON BRICKS — A solid composed of Akon treatment and softening chemicals for internal treatment in low to medium pressure ranges.

No. 26 INTERNAL TREATMENT — Used as oxygen scavenger and sludge dispersive agent for boilers, either internally or externally treated.

No. 30 SERIES — Powdered formulations combining all of the necessary softening chemicals with an organic dispersive material.

SILIMITE TREATMENT — Effective high magnesium dolomitic lime for silica reduction in connection with a hot process lime-soda softener.

No. 40 SERIES — Powdered formulations for scale and corrosion control as supplementary treatment for boilers in *all* pressure ranges.

No. 160 SERIES — A liquid formulation consisting of the volatile amines for corrosion control in condensate return systems.

No. 20 SERIES — Powdered formulations designed to control excessive scale and corrosion problems in plant cooling cycles.

No. 60 SERIES — Powdered formulations for inhibiting corrosion in brine and circulating water systems and low pressure boiler plants.

A-C ANTI-FOAM — An effective formulation to overcome damaging foaming in power plant boilers operating over 150 psig.

HENRY W. FINK, with over 10 years experience in power plant water conditioning, is one of the Allis-Chalmers specialists located around the country to advise you on correct water conditioning equipment, chemicals and service. For free survey, call your nearby Allis-Chalmers office.

FOR OVER HALF A CENTURY, Allis-Chalmers has been building power generation equipment. This experience provides our water conditioning specialists with the extensive background needed today to recommend, not only correct equipment, but chemicals and service as well.

Whatever your industry — paper, petroleum, food, steel — an expert Allis-Chalmers representative is available, ready to recommend proper chemicals or help select the right process for your power plant requirements. Get in touch with him today at your nearby Allis-Chalmers Office.

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Water Conditioning

✓ EQUIPMENT ✓ CHEMICALS ✓ SERVICE

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Gentlemen:

Please send me specific information on the following chemicals:

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. . . TUBES

. . . Nothing but tubes

B&W Tube Co. representatives are pass-keys to all tubing problems—pressure or mechanical . . . carbon, alloy, or stainless . . . special shapes . . . tailor-made physical and chemical properties. They sell tubes, tubes, nothing *but* tubes. Their factory training in "tube-technics" embraces everything from material selection to method of shipment. They are experienced in uncovering unexpected tubing economies. There is one near you. Ask him. He *knows!*

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THE BABCOCK & WILCOX TUBE COMPANY

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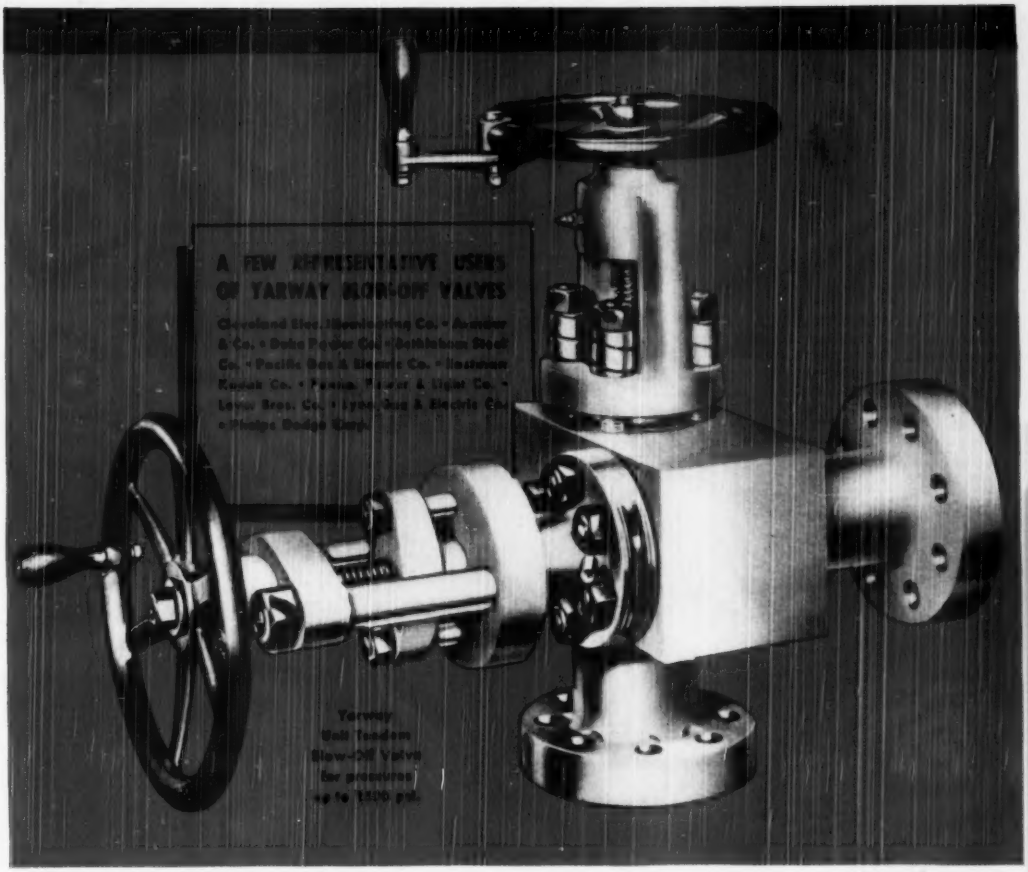

TIGHT! STRONG! for even toughest blow-down requirements

The Yarway Unit Tandem Blow-Off Valve meets the most demanding requirements for boiler blow-down or drain service.

It's drop-tight—and rugged enough to withstand the severe punishment of regular or emergency blow-down under pressure, or periodic acid wash.

Two Yarway Stellite-Seat Hard-Seat Valves or a Hard-Seat (blowing) and Seatless (sealing) Valve are combined in a one-piece forged-steel body. Designed for pressures up to 2500 psi.

It is significant that more than 4 out of 5 high pressure boiler plants use Yarway Blow-Off Valves.

For more facts, see Yarway Bulletin B-432.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
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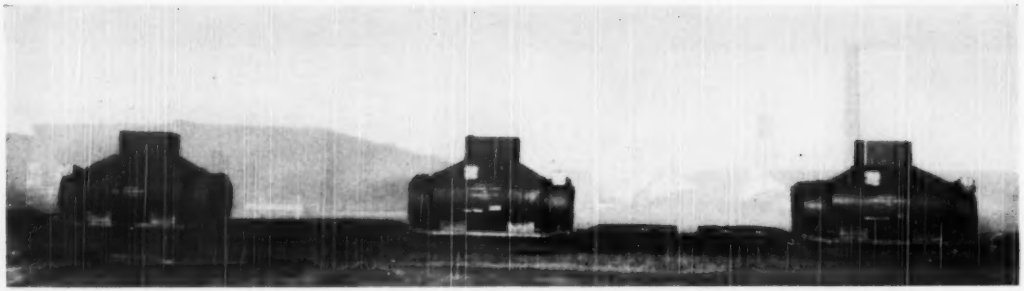
YARWAY

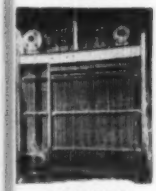
BLOW-OFF VALVES



3—9000 sq. ft. CONSECO Condensers on their way to a Municipal Power Plant in Florida. This 27,000 sq. ft. represents only a small fraction of the millions of exchanger and condenser surface designed, built and erected by Condenser Service & Engineering Company.

MORE CONDENSERS *by* CONSECO . . . . . .

Also:



BOILERS

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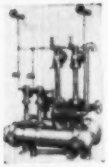
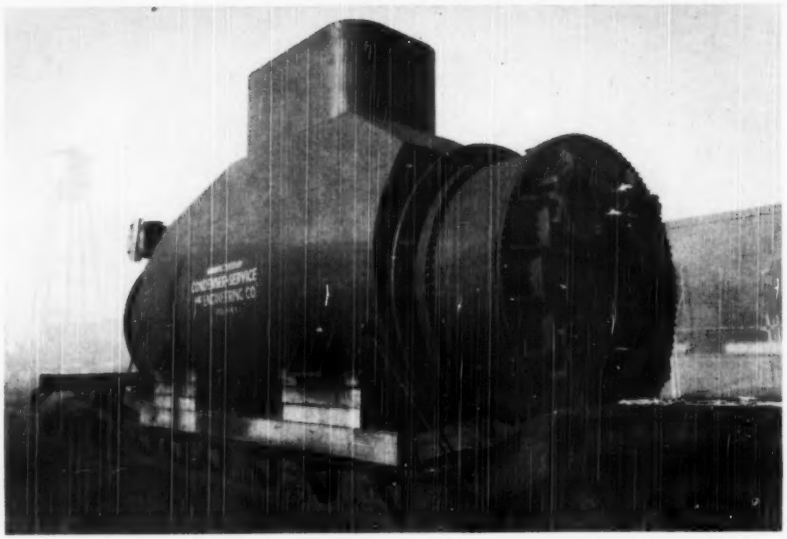
EVAPORATORS



STEAM JET AIR EJECTORS



Close up view of one of the 9,000 sq. ft. 2-pass divided flow condensers shown on cars above. Note the large diameter shell expansion joint; the liberal water box depth and large quick-opening inspection doors; the large diameter reheating steam belt. The cleanliness of the design results from careful consideration of internal structural stiffening and scientifically designed steam flow path.

CLOSED HEATERS

Let CONSECO Engineers design and build your condenser and heat exchanger equipment to your requirements . . . guaranteed to meet or exceed performance specifications.

Write for bulletins covering ejectors, evaporators, condensers, coolers, boilers and pumps.

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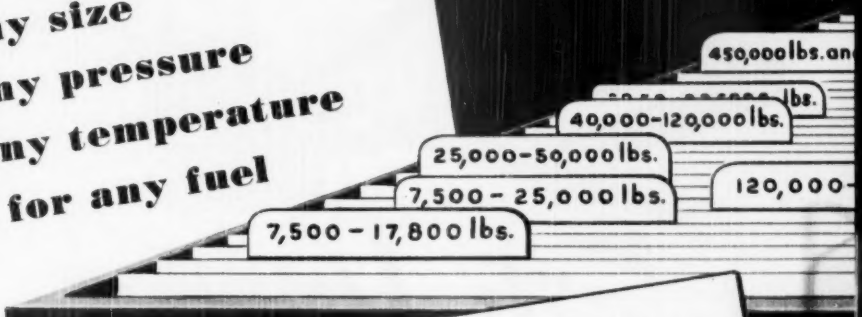
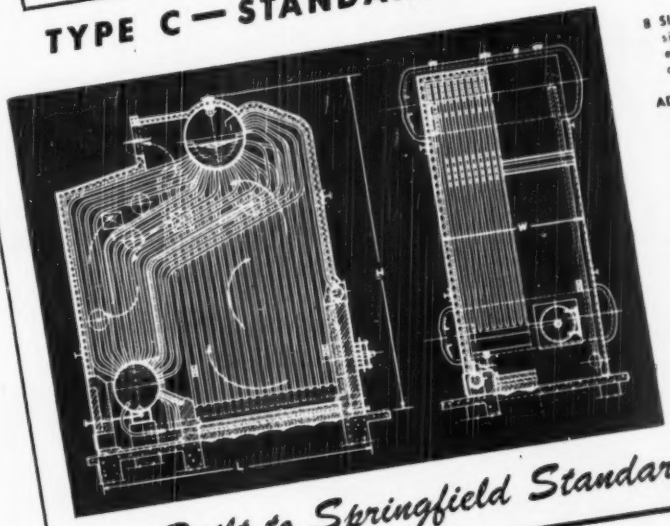
BOILERS
to meet your needs!

...any size
...any pressure
...any temperature
and for any fuel



10,000 – 45,000 lbs. Capacity

TYPE C — STANDARDIZED 2-DRUM BOILERS



8 SIZES—Springfield offers small to medium size plants a wide choice of modern, efficient steam generating units in its line of Type C 2-drum boilers.

ADVANCED DESIGN — Dry steam — steam delivery tubes discharge above water level; positive circulation, high reliability, low maintenance. Standardized construction permits quicker delivery, maximum economy — yet readily adaptable to modification to meet user's particular requirements.

WATER-COOLED FURNACE—Furnace is completely water-cooled in sizes of 20,000 lbs. and over. Superheater, air heater, and economizer, if desired.

OIL, GAS, OR COAL— Built for firing with standard oil or gas burners, spreader or underfeed stokers. See your local Springfield representative, or write.

Built to Springfield Standards of Quality!

See our catalog in SWEET'S

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Dependable Steel Pipe ...Easy to Install

THROUGH the years, the guiding principle at Youngstown has been to make quality steel pipe which is well suited to serve the needs of plumbing and heating contractors and their customers. That's why Youngstown Pipe bends accurately, cuts readily, threads surely, welds easily--properties designed into the product for efficient fabrication, installation and long, satisfactory service.

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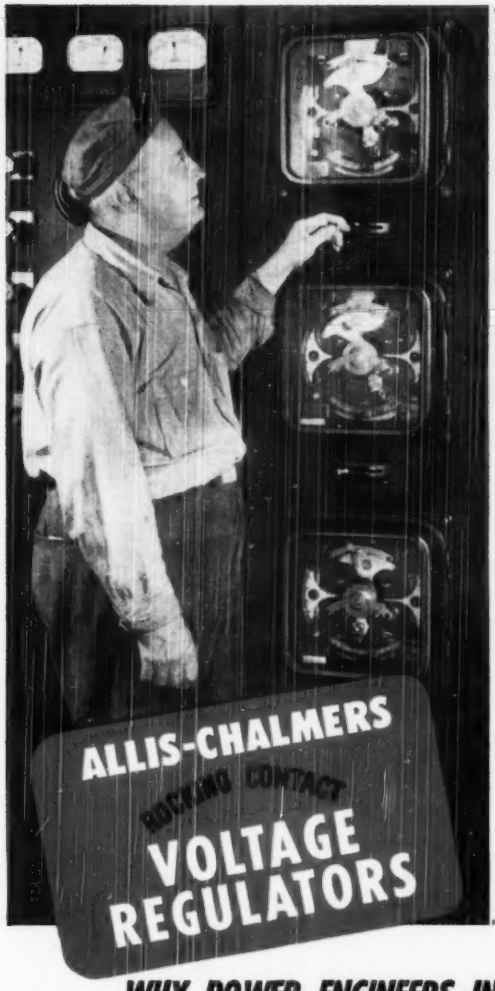

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— SAYS POWER ENGINEER ST. BERNARD, OHIO

ACCORDING TO LEO E. HEIMERT, "Their performance can't be beat. They were put in service nine years ago, and we have yet to see any sign of needed maintenance. Regulation has been tops!"

What are the reasons behind this typical performance?

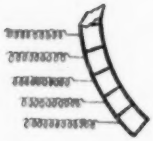
1. Allis-Chalmers Rocking Contact Generator Voltage Regulators have no vibrating contacts, no gliding friction, no complex adjustments. The few moving parts are all supported in jeweled bearings. See below how simple and friction-free this makes the unit.

2. They're genuinely precision-manufactured. Sectors rock on accurately machined commutator segments that are silver surfaced for positive contact, long life.

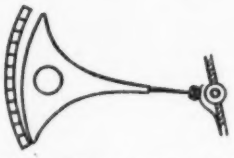
No wonder Allis-Chalmers Rocking Contact Regulators are preferred by many as the finest for their systems! If you want long years of trouble-free service, specify *Rocking Contact* Generator Voltage Regulators for your next switchgear or switchboard . . . or replace inefficient regulation now! Call your nearby A-C representative or write direct. A-2967

ALLIS-CHALMERS, 952A SO. 70 ST.
MILWAUKEE, WIS.

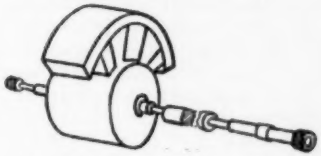
WHY POWER ENGINEERS IN UTILITIES, MUNICIPALITIES AND INDUSTRY PREFER ALLIS-CHALMERS ROCKING CONTACT REGULATORS:



Each commutator segment is connected to a wire wound resistance element that is accurately designed according to the characteristics of *your* generating equipment. Resistance elements are air cooled —commutator is in dust-tight enclosure.



Rocking Contact sector pivots on jeweled bearing . . . has smooth working, hard graphite face that rocks on curved, silver surfaced commutator . . . regulates with slight movement . . . reduces wear . . . maintains accuracy.



Quick acting torque motor drives Rocking Contact Sector . . . has jeweled bearings for rapid, accurate, anti-friction movement. Aluminum rotor reduces inertia . . . increases speed of response.

ALLIS-CHALMERS

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Speeding express trains and thundering freights can cause serious vibrations with damaging effects on equipment located nearby. Here's a C. H. W. water cooling tower installed so close to one of the country's heaviest traveled railroads that passing trains nearly knock your hat off. This tower of The Bayer Company, aspirin manufacturers at Trenton, N. J., is as good as the day it was built. And there are many good reasons why they haven't had any "headaches" with it. In a C. H. W. cooling tower you get a sturdy structure, assembled by experts, with redwood members rugged enough to withstand stresses, strains and vibrations (caused by trains or most anything else up to hurricane winds of 100 m. p. h.). Wood fill is of sufficient size and weight to "stay put" without the use of nails, and vertical members are securely bolted. A distorted distribution system or wood fill "out of place" affects the efficiency of the tower—hence the reason for C. H. W.'s "vibration proof," rugged construction. For other exclusive features of C. H. W. towers, write for literature.

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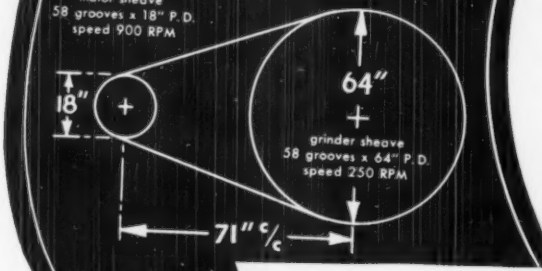
GIP-Specified V-BELT DRIVE FOR PAPER MILL GRINDER



WORLD'S largest V-Belt drive, the above pulp grinder installed in a Wisconsin paper mill is belted with 58 Goodyear HY-T Multi-V-Belts built with synthetic cords. The sturdy synthetic cords that body these belts are designed especially to "give" slightly without snapping under sudden, jolting loads that break ordinary belts. Ask the G.T.M.—Goodyear Technical Man—about HY-T Multi-V-Belts for normal speed, heavy shock-load drives, as well as the other Goodyear V-Belt constructions to meet specific drive demands.

FOR HOSE, FLAT BELTS, V-BELTS, MOLDED GOODS, PACKING, TANK LINING built to the world's highest standard of quality, phone your nearest Goodyear Industrial Rubber Products Distributor.

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GOODYEAR

HY-T—T.M. The Goodyear Tire & Rubber Company

THE GREATEST NAME IN RUBBER

WHAT FUEL?

[The power or heating plant represents such a vital part of any structure that it seems both illogical and unwise to tie it down to any specific fuel without thorough consideration of ALL the facts.]

In selecting the type of fuel for heating or power generation, these basic factors demand careful thought:

1.	Long Range Availability	of Primary Importance
2.	Dependability	of Primary Importance
3.	Safety	of Primary Importance
4.	Cost	Important
5.	Comfort and Healthfulness	Important
6.	Uniform Temperature or Steam Supply	Important
7.	Service and Upkeep Cost	of Secondary Importance
8.	Cleanliness and Convenience	of Secondary Importance
9.	Automatic Plant Operation	of Secondary Importance

Of the advantages implied by these factors, the first three belong almost exclusively to coal. With modern firing methods, coal stands equal, if not superior to other fuels in all regards. Nevertheless, reasonable men, impelled by a hysteria of headlines, are totally disregarding the facts in designing and selecting heating and power plants.

Let's consider ALL the facts.

(1) Over the life of the average steam plant (30 years), coal has always proved the most stable, economical fuel.

We are now importing oil to supplement our dwindling reserves but the East Coast knows that oil imports are easily stopped by war, strikes and emergencies. Even war-time-built pipe lines could not be counted on to meet the oil demands of a national emergency.

Natural gas reserves are being depleted and producing states are considering curtailment of export to conserve reserves for use of their own citizens.

On the other hand, coal reserves are almost unlimited; vast, widely-scattered deposits offer a dependable supply for generations to come.

(2) Coal is dependable. It is the only fuel which can be safely and economically stored in large quantities. There are no losses from leakage, no pressure drops or sudden, unexpected supply failures. It is the only fuel which can be hand-fired in event of failure of the firing equipment.

While industrial strife in the coal industry has made bold headlines, *few, if any users have found themselves without sufficient fuel to meet vital needs.*

(3) The safety of coal is unquestioned. It is non-explosive, not easily ignited, cannot leak deadly fumes.

(4) Despite price increases coal remains the most economical fuel. Gas prices are under strong upward pressure and oil prices are practically always higher than those of coal.

(5) The greater comfort and healthfulness of coal heat is generally recognized. Coal provides steady, uniform heat, burns quietly, and gives off no unpleasant, unhealthful or lethal fumes.

(6) Coal heat is uniform. Coal's flexibility makes it easy to meet peak steam demands economically without expensive oversize or special equipment. Pressure does not drop when the mercury falls.

(7) Since coal can be fired by sturdy, dependable stokers requiring no piping, valves, pressure regulators or delicately-adjusted controls, original plant cost and maintenance and service costs are low.

(8) Coal can be both convenient and clean to use. Hopper-type bins and other handling equipment make coal easy to burn. Proper firing and overfire air jets almost completely eliminate smoke and soot while modern grate design does away with clinker "pulling" and permits ashes to be "wetted down" before removal to prevent dust and fumes.

(9) With modern stokers and dependable automatic combustion control systems, coal-fired boilers require no more attention than any other type.

Finally, coal is, and always has been a basic part of our national economy. Its mining, transportation, distribution and the mechanical industries serving the coal market represent a vast investment and give employment to over a million workers.

Let's be calm and reasonable. We cannot afford to jeopardize health, safety, convenience and investments by hasty action. Consider ALL the facts; then *provide for coal,* the basic and unlimited fuel, in your power and heating plans. Other fuels may serve for temporary situations but primary dependence on them is dangerous and may prove costly.

CANTON STOKER CORPORATION

Designers and Builders of Stokers and Other Equipment for Safe, Dependable, Economical Coal Firing

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The WeldELL line is a quality line in the fullest sense of the word. It is the expression of all that has been learned in a half century of continuous research and practical experience by an organization that has consistently shown the way in forging technique and closely-controlled metallurgy as related to piping design.

The quality line—the job-speeding, cost-cutting line—is also the *broadest* line. It includes practically every type of fitting, in every weight, every size and every material needed in pipe welding. Large stocks are carried in all industrial centers.

Mail coupon for new catalog covering WeldELLS and other Taylor Forge Welding Fittings.

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Taylor Spiral Pipe is again promptly available in a broader range of sizes and thicknesses. Coupon brings pipe bulletin.

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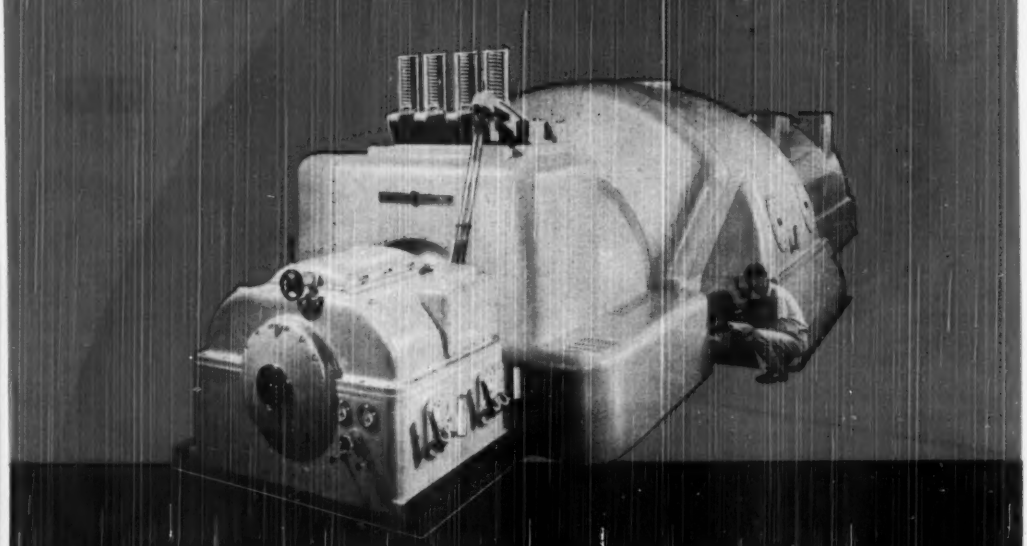
Now—SURE PROTECTION AGAINST RUST in steam turbine lubricating systems—



GULF TURBINE FLUSHING OIL

Now—Gulf Turbine Flushing Oil has been further fortified to provide an even more effective rust preventive film! Now you can be sure that all oil bathed surfaces in your new turbine lubricating system are completely protected!

Gulf Turbine Flushing Oil has highly preferential wetting characteristics — displaces water quickly on the internal surfaces of the lubricating system. It should be used as soon as practical after installation of the system.

Gulf Turbine Flushing Oil has excellent flushing action — cleans inaccessible parts of the system, readily picks up dirt particles and carries them to the filter.

An important advantage of Gulf Turbine Flushing Oil over other types (such as certain solvents) is that the undrained portion in the turbine system does not impair the lubricating value of the turbine oil. For Gulf Turbine Flushing Oil is itself a satisfactory lubricant.

Only one-third to one-half of a normal turbine oil fill is required for thorough flushing. Thus the expense of flushing your new turbine with low-cost Gulf Turbine Flushing Oil is nominal.

For complete information on this quality product and for recommended procedure for cleaning your turbine, call in a Gulf Lubrication Engineer. Write, wire, or phone today.

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WEIRTON STEEL COMPANY'S Boiler Plant facilities have been twice expanded by Dravo Corporation to keep pace with increasing requirements. Latest (1947) extension adds another complete unit to the high pressure boiler plant and 325,000 lbs. per hr. to steam output. Dravo-built boiler plants serve companies which produce more than 47% of the nation's steel.

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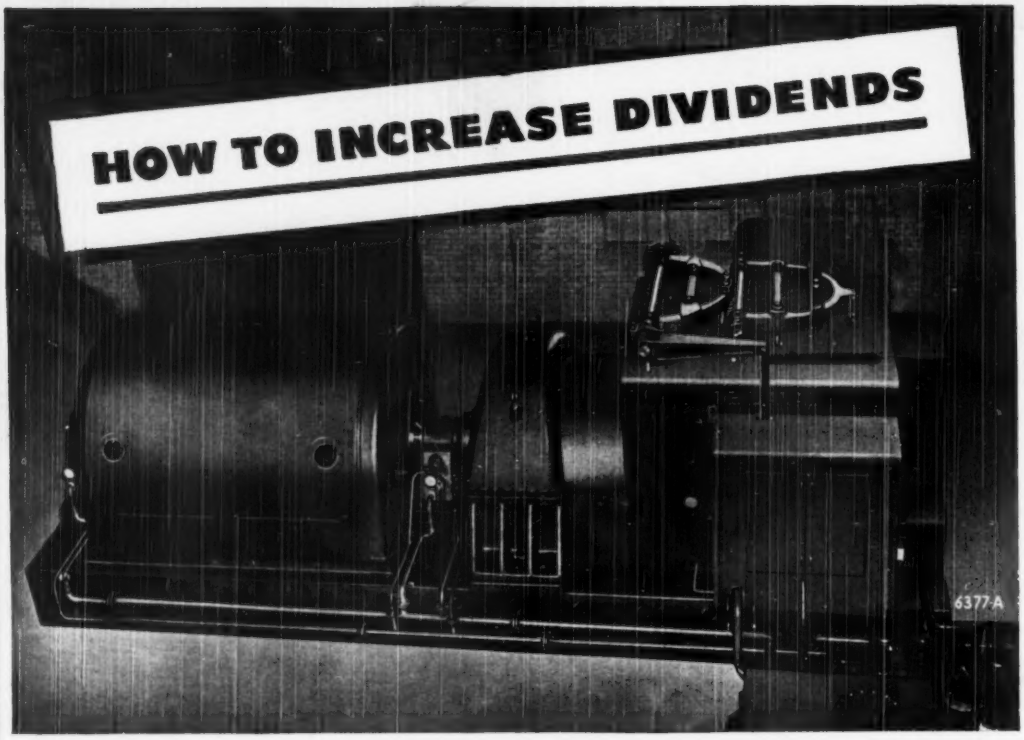
HOW TO INCREASE DIVIDENDS



Ask your consulting engineer about the economy of producing power as a by-product!

When steam is required for heating or processing, the cost of producing *power* as a by-product is so low that it is not unusual for the installation of a modern De Laval Turbine Generator to realize savings of as much as one-tenth or one-quarter of a company's total paid out dividends.

Why not sit down with your consulting engineer and make a careful study of your present power plant. It may pay dividends for your company too!

For preliminary information send for Catalog 4205-28-P.

DE LAVAL STEAM TURBINE CO., TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

POWER

CROSS-INDEX OF SUBJECTS FOR THE MONTH

APRIL 1950 · VOL 94 · NO. 4

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PUMPS, COMPRESSORS

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Cover shows typical air-washer spray bank — courtesy Buffalo Forge Co

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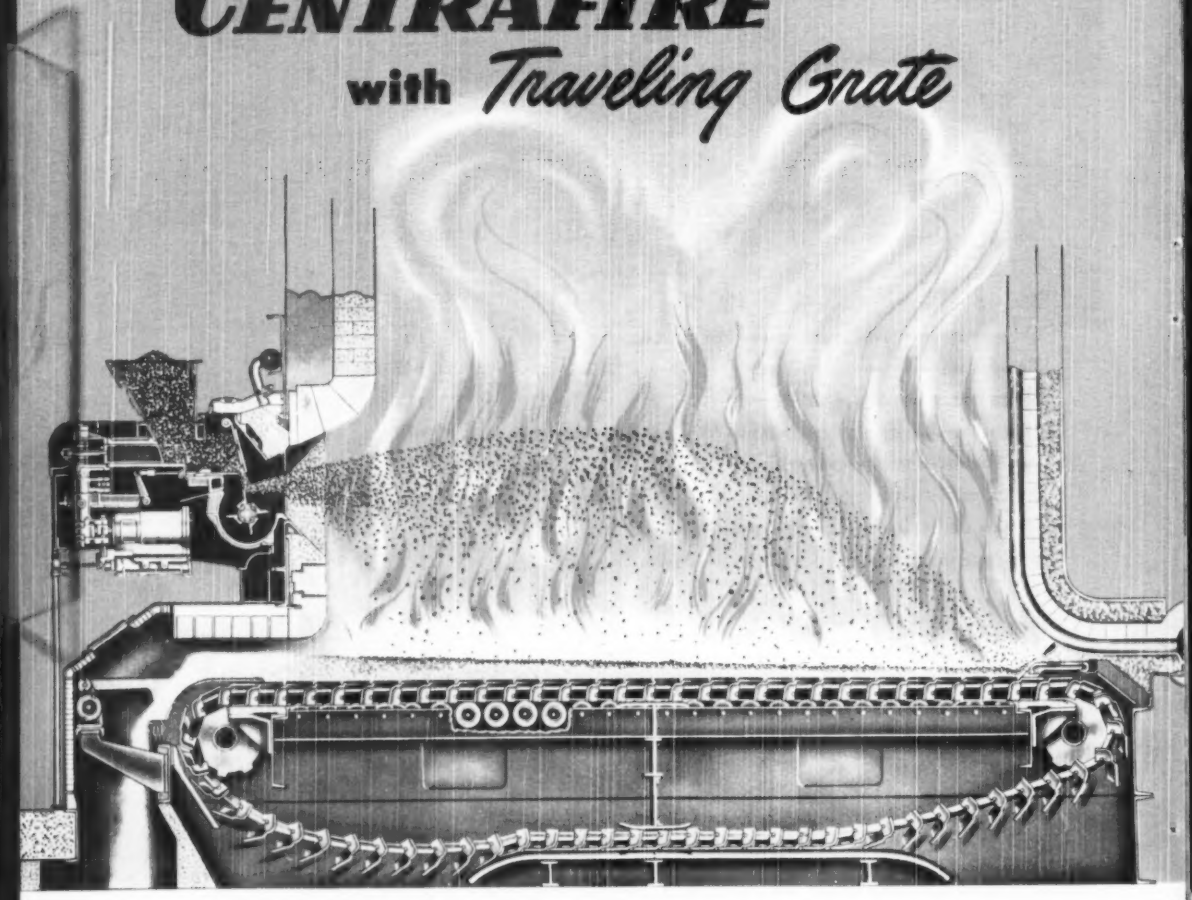
with *Traveling Grate*



Westinghouse

STOKERS

. . . . . brings Extra Engineering Refinements To Spreader-Type Firing

The outstanding performance of the Centrafire with Traveling Grate stems from features that are built in—not added as accessories.

A positive, metered flow of coal, wet or dry, is fed continuously by an air-cooled overthrow rotor into the combustion area. Proper distribution is effected automatically by cyclic control of the rotor speed.

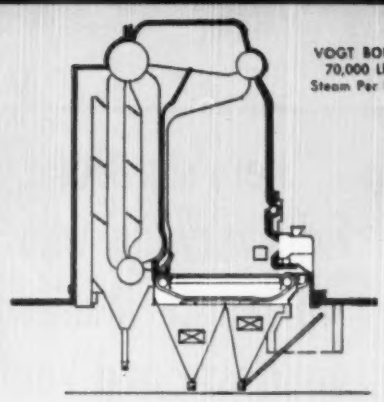
All moving elements are hydraulically operated by one turbine or motor-driven oil pump. This assures infinite flexibility through the complete range of operation—synchronizes coal feed and grate speed.

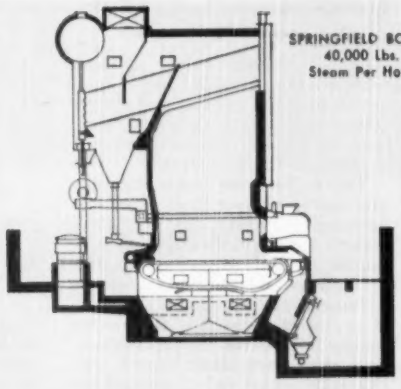
Grates are plate-type, laboratory tested under conditions far more severe than those of actual service. Rollers support the grate chains, reducing friction and power requirements.

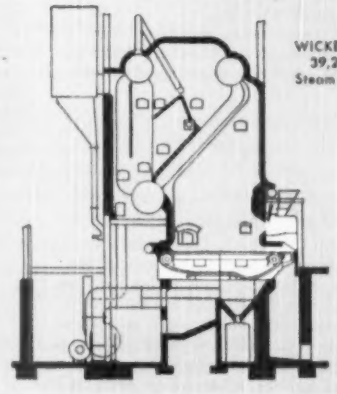
Fuel distribution adjusted automatically to air flow through front and rear grate sections results in intimate mixing of fuel and air for thorough combustion.

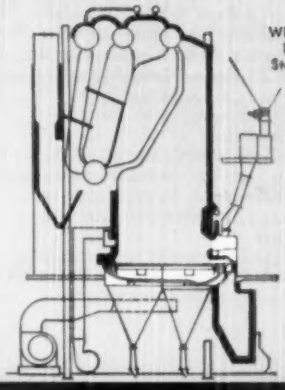
The Centrafire's range extends upward of 300,000 lbs. of steam per hour. Its adaptability to deep, narrow furnaces permits use of the most economical boilers.

It will pay you to get the full Centrafire story. Ask your Westinghouse representative for complete data, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-30504

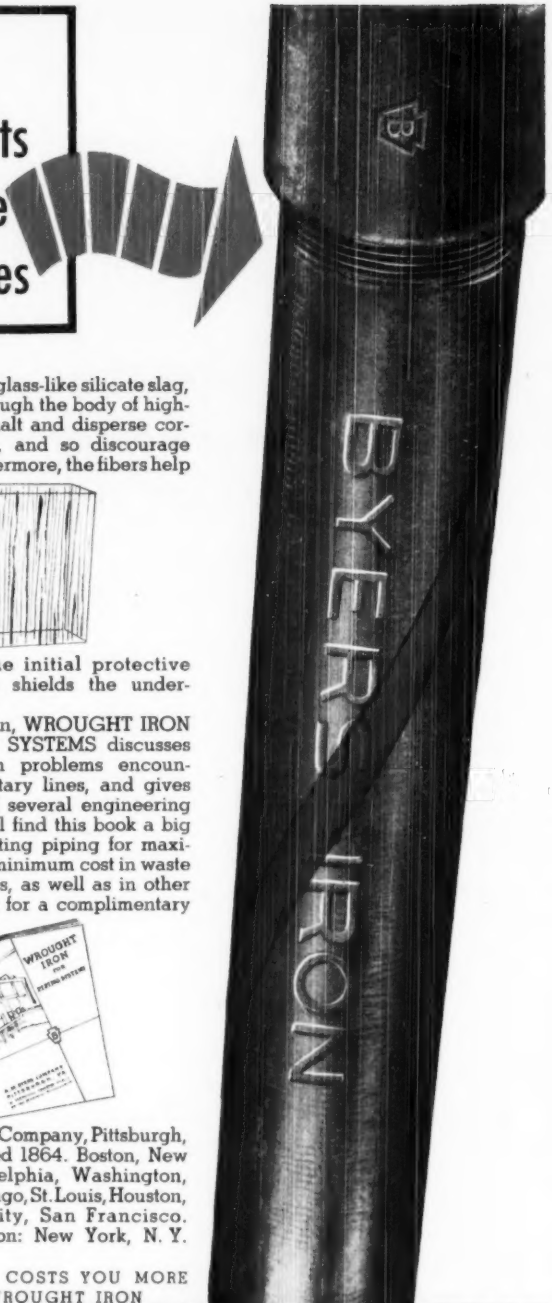

VOGT BOILER
70,000 Lbs.
Steam Per Hour


SPRINGFIELD BOILER
40,000 Lbs.
Steam Per Hour


WICKES BOILER
39,200 Lbs.
Steam Per Hour


WICKES BOILER
110,000 Lbs.
Steam Per Hour

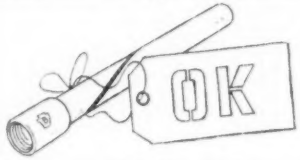
Here's a Good Tip for Everyone who wants to reduce Maintenance on Waste and Vent Lines



It's safe to say that *every* building with sanitary facilities has a corrosion problem . . . and that unless proper safeguards are used, you'll soon be paying for repairs, with replacement not far ahead.

Two of the worst trouble-makers are waste and vent lines. They are exposed to multiple attack from water . . . organic wastes . . . oxygen from the air . . . carbon dioxide . . . and sewer gases, which include ammonia and hydrogen sulfide. Any one of these is a dangerous enemy to pipe life. In combination, they represent a major hazard, and the only practical protection is through the use of a corrosion resistant material.

Wrought iron has been used in these severe services for long periods, and its superior durability



has been certified by service records of 50 years or more. In one study of a number of old buildings, wrought iron vents were still serving in one building after 49 years —in two after 48 years . . . and in three others after more than 45 years. In contrast, in a group of eleven buildings where low-first-cost materials had been used for vents, the life *to failure* averaged less than 23 years. In another study of a group of buildings over 20 years old, the engineer estimated the depreciation as 20% for the wrought iron vents, and 90% for the other material. Similar impressive performance figures support the choice of wrought iron for waste lines.

You'll find the reason for wrought iron's unusual durability in its unique composition and structure. Tiny fibers of glass-like silicate slag, threaded through the body of high-purity iron, halt and disperse corrosive attack, and so discourage pitting. Furthermore, the fibers help

to anchor the initial protective scale, which shields the underlying metal.

Our bulletin, WROUGHT IRON FOR PIPING SYSTEMS discusses the corrosion problems encountered in sanitary lines, and gives the results of several engineering studies. You'll find this book a big help in selecting piping for maximum life and minimum cost in waste and vent lines, as well as in other services. Ask for a complimentary copy.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, Salt Lake City, San Francisco. Export Division: New York, N. Y.

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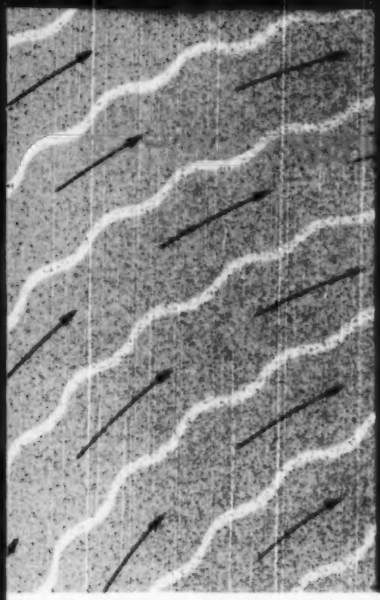

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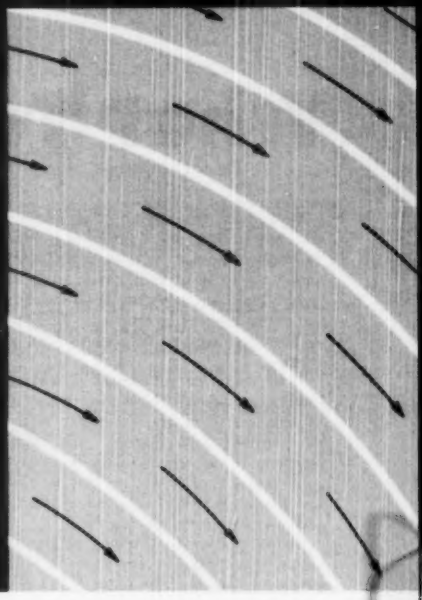


AIR CONDITIONING

By J C McCABE, *Associate Editor*

Air conditioning is an engineering service that pays for itself by (1) improving comfort (2) increasing worker efficiency (3) bettering industrial processes. It does its job by providing the ideal climate for the particular circumstances.

What makes an ideal climate depends on who wants it and why. In industrial work the specifications set up are apt to be as individual as the products manufactured. For instance, electrical insulation makers want high temperature and low relative humidity, while for some textile operations high humidity is the prime need. And so it goes.

How about comfort air conditioning? No two people are exactly alike in what they consider comfortable conditions. By extensive testing, however, certain combinations of temperature, humidity and air movement have been proved comfortable to most people. It also turns out that these factors are to some extent equivalent or interchangeable. Thus it has been possible to arrive at an index of comfort—known as *effective temperature*—which combines these three factors. Properly interpreted, this serves as a guide in setting comfort conditions.

For either industrial or comfort conditioning, means are available for altering the properties of air to those desired. This may involve cleaning, heating or cooling, humidifying or dehumidifying, and controlling distribution of air. How many of these basic operations are involved depends on the goal in mind. Comfort conditioning frequently requires all of them; industrial conditioning, as we have seen, may emphasize one or two phases.

As a major service in many plants and buildings, air conditioning represents another of the power engineer's manifold responsibilities. Much of the equipment used is familiar from heating, ventilating and refrigeration practice, while some is unique to the air-conditioning job. Most important of all, successful air conditioning depends on a knowledge of the properties of air and how they may be juggled to bring about desired results.

Thus this special section, POWER's 75th, gives a simplified presentation of first principles, plus a broad picture of the tools that put these principles to work. Emphasis naturally falls on equipment specifically developed for air conditioning, with a passing glance at familiar devices that also play a part in the job. The story is then buttoned up by showing how these elements are combined to meet the needs of any given application. The whole forms a practical primer on a power service of evergrowing importance in industrial plants, buildings and institutions.

What You Need to Know

Behind the application of air conditioning lies an understanding of what air is and how it behaves. Pure dry air is, we know, a mixture of oxygen and nitrogen. It also contains small amounts of rare gases, such as argon, but we can forget them. Air as we find it all around us, however, contains moisture in varying amounts. Thus the stuff we deal with in conditioning can be regarded as a mixture of air and steam.

How come we get steam at atmospheric pressure and low temperatures? The answer is that while the mixture is at atmospheric pressure, the water vapor isn't. It is actually at extremely low pressure. And since we know that the temperature at which water boils or vaporizes gets lower as pressure goes down, we can see that at these extremely low pressures water will exist in the form of steam even at ordinary temperatures, say 70 F.

Partial Pressures. These low pressures come about because, if we mix any two gases in a given space, each acts pressure-wise as if the other didn't exist. Each is under the pressure it would have if it occupied the space by itself. Pressure of the mixture is the sum of the two *partial pressures*.

To see how this works let's start with steam at 70 F. Its absolute pressure at that temperature is 0.74 in. Hg. And 0.0011 lb of it would fill one cu ft. Now if we add enough air to make one cu ft of mixture, what do we have? Total pressure, we know, will be atmospheric pressure, say 30 in. Hg. Then the partial pressure of the air must be 30 −0.74, or 29.26 in. Hg.

Steam Properties. Since the water vapor or steam always acts as if there were no air present, we can get a clearer picture of how moist-air mixtures behave if we review steam properties briefly. We remember that if we heat water at some given pressure, its temperature rises. Finally, we reach a point where the water boils or vaporizes. Temperature holds steady at this point until all water has become steam. If we continue to add heat, steam temperature starts to rise and we have superheated steam.

Now if we take away heat, we lower the temperature of the steam. This goes on until we reach the temperature at which the steam vaporized. If we still cool the steam, some of it condenses. This continues, at a constant temperature and as long as we take away heat, until all the steam is condensed back to the liquid.

The important point to remember is that for any given pressure, there is one temperature at which steam starts to vaporize or condense. This is known as *saturation* temperature. It depends entirely on pressure, being lower at low pressures. Furthermore, steam at any given pressure and saturation temperature has a certain density.

For convenience, let's put down some of these figures in our general range of interest:

Temperature	*Corresponding absolute pressure of saturated steam, in. Hg*	*Density lb/cu ft*
40	0.258	0.0004
50	0.36	0.0006
60	0.52	0.0008
70	0.74	0.0011
80	1.03	0.0016
90	1.42	0.0021

A complete set of values will be found in the familiar tables of the properties of steam.

Now let's assume we have a cubic foot of moist air at 70 F and we find that it contains 0.0004 lb of moisture. A glance at the little table above shows that at 70 F a cubic foot will hold 0.0011 lb of steam. Since we have less, the steam must be superheated, and the table tells us how much: 70 −40, or 30 F.

Relative Humidity. We can see that our cubic foot holds less moisture than it could hold. The term *relative humidity* is a measure of this. Here we have 0.0004 lb when we could have 0.0011. Ratio is 4:11, or 36%. This is the relative humidity. Notice that it is based on volume—cubic feet of moist air. The term *percentage humidity* expresses the same general idea in terms of weight. It is the weight of moisture actually mixed with one lb of dry air, compared to the weight of moisture that could be mixed with one lb of dry air at the same temperature.

Dewpoint. Now let's take our mixture, with 0.0004 lb of moisture in a cubic foot, and cool it down. Referring to the table again, we see that if we cool it to 40 F, it will be holding all the moisture a cubic foot can hold at that temperature. It has 100% relative humidity. Such a mixture is called *saturated*. If we try to cool this mixture further, some of the steam will condense. Temperature at which this condensation starts, in this case 40 F, is *dewpoint* temperature. As we can see, the dewpoint of any mixture of air and water vapor depends entirely on how much moisture is present. For example, a cubic foot containing 0.0006 lb of water vapor has a dewpoint of 50 F.

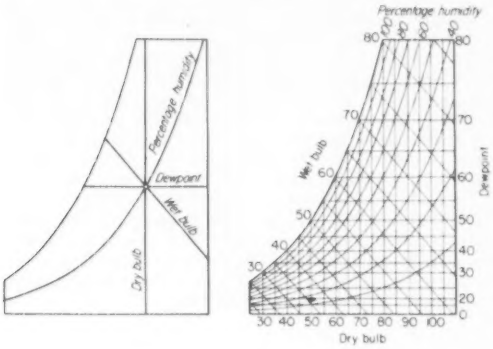
Practical Application. Right here we can pause for a moment and see one of the ways this knowledge of air properties can be put to work. Suppose outside air is 80 F and we find it contains 0.0011 lb of moisture per cu ft. This is about 69% relative humidity. Now let's say that we want to condition this air to 70 F and 50% relative humidity. Saturated air at 70 F would have 0.0011 lb of moisture; 50% of this would be 0.0005, disregarding the next decimal place. Looking at the table, we see that if we cooled the air down to about 45 F, moisture would condense out until only 0.0005 lb is left. Let's drain off the condensate so it can't get back into the air. Now if we reheat to 70 F, there is only a temperature change and no change in moisture content. Thus we wind up with 70-F air containing 0.0005 lb of water vapor per cu ft, which corresponds to the 50% relative humidity wanted. This little example is typical of the kind of juggling with air properties that makes air conditioning possible.

Wet-Bulb Temperature. We can't go around measuring the amount of moisture in each cubic foot of air we deal with. Fortunately we don't have to — with a *wet-bulb thermometer* and a *psychrometric chart* we get the answers. We make the first of these gadgets by covering the bulb of an ordinary thermometer with wetted silk gauze and placing it in a moving air stream. Some of the water in the gauze will evaporate. Since vaporizing takes heat, it will come from the remaining water and its temperature will drop. How much depends on how dry the air is and its temperature. When things settle down, the thermometer reads *wet-bulb temperature*. This, with the dry-bulb temperature read on an ordinary thermometer, tells us how much moisture is in the air and other things we want to know about it. We consult a psychrometric chart to find our answers.

Psychrometric Chart. Fortunately the properties of moist-air mixtures always follow the same rules, so we can figure them out once and for all and put them in the form of a chart. These can be plotted in several different ways but the basic principles are the same.

About Air Properties

Below is a typical chart in skeleton form and, alongside it, one with some of the lines filled in. This follows the form developed by Trane Co. As the skeleton shows, the chart is a plot of percentage humidity (some charts use relative humidity), wet-bulb and dry-bulb temperature, and dewpoint. By use of auxiliary scales, as we'll see later, many additional useful data can be obtained from the chart. And for "seeing" how air properties change, the chart is valuable because we can trace on it the basic air-conditioning processes. We'll do some of this tracing later.



1 TYPICAL PSYCHROMETRIC CHART ELEMENTS

Sling Psychrometer. Since wet- and dry-bulb temperatures can be measured readily, these are usually what we start with. For convenience, we can use a *sling psychrometer*. This consists of an ordinary thermometer and one with a wetted-gauze-covered bulb, mounted on a single bracket. This has a handle so the whole outfit can be whirled around rapidly to get the air movement past the wet bulb that we need. Both temperatures can then be read at the same time.

Latent Heat. We've seen in passing that vaporizing water into steam requires adding heat, while condensing steam back into water requires taking heat away. It's the same amount in each case and, for the low-temperature range we're interested in, it's about 1050 Btu per lb. This is called *latent heat*.

Exact amount of latent heat varies with dewpoint. So now we can paste in our hats the twin facts that both latent heat per pound of vapor and maximum weight of vapor that can be associated with a given quantity of air depend on dewpoint alone.

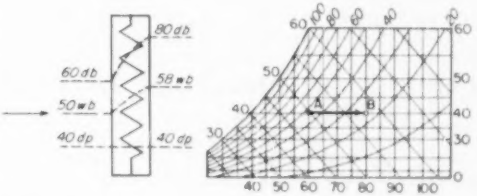
Sensible Heat. We've just seen that latent heat goes with a change from liquid to vapor, or from vapor to liquid. No temperature change is involved. But we know we have to add heat to raise temperature. This heat that goes to change temperature we call *sensible heat* (you can feel it). Amount of sensible heat depends on temperature and the specific heat of the substance. For dry air we can take specific heat as about 0.24 Btu per lb.

For convenience, sensible heat is measured above 0 F. So to figure sensible heat all we have to do is take the temperature and multiply it by 0.24 and we get our answer in Btu per lb.

Total Heat. If we had dry air alone, sensible heat would be the total heat. If we had water vapor alone its total heat would be sensible heat plus latent heat. For usual air conditions, sensible heat of moisture is extremely small, so we can neglect it. Thus total heat of moist air may be taken as sensible heat of dry air plus latent heat of vapor. For all practical purposes, it can be said to depend only on wet-bulb temperature, just as sensible heat depends on dry bulb, and latent heat on dewpoint. A reminder: dry bulb, wet bulb, and dewpoint are the same for a saturated mixture.

What Conditions? Before we take a look at some of the basic air-conditioning processes, let's review briefly what we're shooting at. In industrial work, the nature of the process sets the conditions we want to reach. In comfort work, we use the *effective temperature chart* — mentioned before — as a guide. To the answers it gives we must apply judgment, because comfort is affected by many factors not covered by the chart. For example, how long we're going to be in the conditioned space makes a difference, as well as the temperature outside the space. How active we are has a lot to do with it, also. And radiant-heat transmission from or to surrounding walls comes into the picture. Finally, we have to decide how much comfort we can afford to provide under a given set of circumstances.

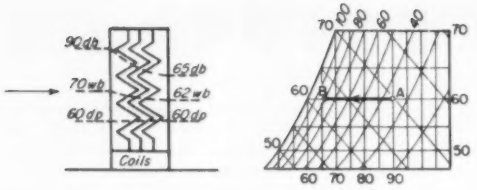
Heating Process. Now let's take a bit of exercise with what we've learned about air properties by tracing some common air-conditioning processes on the psychrometric chart. To save space, we just show a section of the chart in each case; if you'll turn back once in a while to the skeleton chart of Fig. 1, you'll see the whole picture.



2 HEATING WITHOUT MOISTURE CHANGE

Suppose we try heating first. We start with air at 60-F db (shorthand for dry bulb), 50-F wb and about 40-F dp. Pass this through a standard heating coil and what happens? Fig. 2 shows the changes diagrammatically and on the psychrometric chart. Since we haven't added or taken away any moisture, dewpoint doesn't change. And that means that latent heat won't change. We do increase the air's sensible heat and dry-bulb temperature goes up. Total heat goes up also, and so does the wet-bulb. Line *A-B* on the chart shows the change, as we move along a line of constant dewpoint. For this case, we wind up with 80-F db and about 58-F wb.

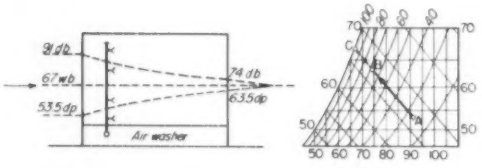
Cooling Process. As you might expect, cooling is the reverse, as long as we don't cool enough to cause some condensation. Let's start with 90-F db, 70-F wb and 60-F dp (point *A*, Fig. 3). Let's cool down to 65-F db (point *B*). The wet bulb turns out to be 62 F and the dewpoint, of course, stays at 60 F. Why, "of course"? If no moisture



3 COOLING WITHOUT MOISTURE CHANGE

condenses out, the only change has been sensible cooling and dewpoint isn't affected.

Spray Humidifying. One way of adding moisture to air, *or humidifying*, is by passing it through water sprays. This is done in *air washers*, typical examples of which are shown on pp 83-85. Suppose we start with air at 91-F db, 67-F wb and 53-F dp, and water, at 67 F. Let's further suppose that we recirculate the water, without either heating or cooling it. Being at the same temperature as the air wet-bulb, water temperature will not change. It can neither add nor remove heat from the air. Yet if we are to have evaporation, we must have a heat transfer. What happens is that the air's sensible heat changes into latent heat. This supplies the heat needed for vaporizing some of the water. In the process, the air dry-bulb goes down. Total heat of the air does not change, merely the proportions of sensible and latent heat.



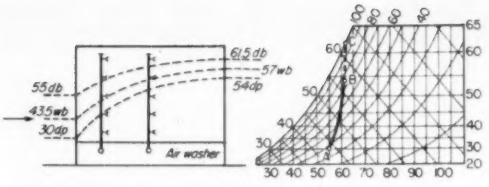
4 COOLING AND HUMIDIFICATION SPRAYS

Because the moisture content of the air changes, the dewpoint rises. If there were time enough for the process to go to completion, and everything went perfectly, air would leave the washer saturated at the wet-bulb temperature. Thus the dry-bulb would drop to the wet-bulb, and the dewpoint would rise to it. Since no washer is perfect, these results are only approached in practice. What we have accomplished is cooling (dry-bulb is reduced) and humidification (moisture content increased).

Suppose the water temperature hadn't been the same as the air's wet-bulb? If it were recirculated without heating or cooling, it would soon reach the air's wet-bulb temperature and would then stay there.

Heating, Humidifying. In winter, we might want to heat the air as well as humidify it. To do this, we've got to have water at a temperature above the air's dry-bulb. We've also got to add heat to it continuously to keep the water from assuming the air's wet-bulb temperature. We've just seen that this is what it would do if we just recirculated it. Fig. 5 shows what happens.

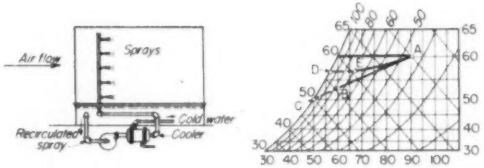
Air enters at 55-F db, 43.5-F wb and 30-F dp. (point *A* on the chart). Condition of the leaving air is shown at point *B*: 61.5-F db, 57-F wb and 54-F dp. We can see that this is not merely a shift of sensible and latent heats, as before. Wet-bulb has gone up, so total heat has gone up, too. Heat



5 HEATING AND HUMIDIFICATION SPRAYS

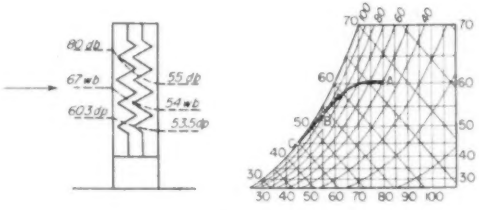
added to the air to bring about this total heat change came from the spray water and that's why we arranged to heat the spray water rather than merely recirculate it.

Cooling, Dehumidification. Taking moisture out of air by passing it through water sprays sounds queer, but it works. The trick lies in keeping the water temperature below the air's dewpoint. Fig. 6 shows what happens. This time we put a cooler in the washer-water circuit to take away heat and hold temperature of the water below the air's dewpoint. Air gives up enough heat to the water to drop its temperature below the dewpoint and some of its moisture condenses out. Line *AB* shows what would happen if water temperature could be held constant, with point *C* being the final water temperature. If spray-water temperature rises while it is in contact with the air, and it will, line *AD* represents a more practical case. As long as final temperature of the spray water is held below the air's initial dewpoint, both cooling and dehumidification will occur.



6 COOLING AND DEHUMIDIFICATION SPRAYS

Dehumidifying With Coils. Cooling and dehumidifying can be done with coils as well as with water sprays. Again the trick lies in keeping the coil temperature below the air's initial dewpoint. Fig. 7 shows the process. We start with air at 80-F db, 67-F wb, and 60.3-F dp. The cooling coils pull these figures down to 55-F db, 54-F wb and 53.5 dp. You



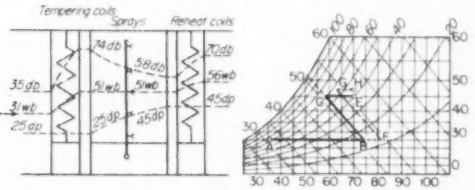
7 COOLING AND DEHUMIDIFICATION COILS

may wonder why the line for this process, *AB*, differs in

shape from the line *AD* for washer dehumidification, Fig. 6. Here's the reason: with sprays, water temperature rises during the process, while with coils, temperature of the air film in contact with the coils, which sets airstream conditions, goes down as successive coil rows are passed. Where point *B* falls depends on coil design.

Coils and Sprays. Some installations do heating and humidifying in separate steps, Fig. 8. Ahead of the washer we have *tempering coils* and after it we have *reheating coils*. Washer spray water is recirculated without heating or cooling.

Air enters the tempering coils at point *A* on the chart. In the coils, it gains sensible heat without change of dewpoint. In the washer, it is cooled along a line of constant wet-bulb, with no change in total heat; some of its sensible heat is converted to latent heat. We come out of the washer with air that is nearly saturated and at a dry-bulb temperature that is lower than desired, even though it is higher than the entering air. We then use the reheating coils to pull the dry-bulb to the desired level and correct the humidity to a proper level. We can see that for any given set of outside conditions and desired inside conditions, we can adjust the amount of heating in the two sets of coils accordingly.



8 HEATING BY COILS, HUMIDIFYING SPRAYS

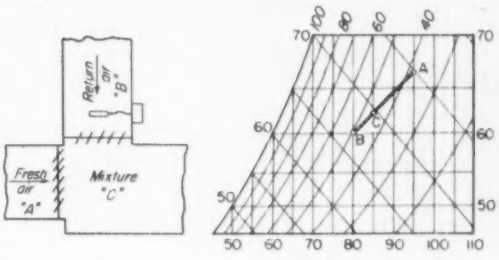
Process on the psychrometric chart runs from *A* to *B* to *C* to *E*. Final dewpoint is really set by tempering coils. For example, if we raised temperature of the entering air further, to point *F*, temperature of the spray water will rise to meet the new wet-bulb. This changes the air condition leaving the washer to point *G*, a higher dewpoint. We then reheat to H, which gives the same final dry-bulb as before, but with a higher wet-bulb and higher relative humidity.

Chemical Dehumidification. Certain materials, called *sorbents*, are used to take moisture out of air. (see pp 85-87 for data on materials and methods). Latent heat released by the condensing moisture adds to the air's sensible heat and raises its dry-bulb temperature. We might expect this heat gain to be balanced by the latent-heat loss, with total heat and wet-bulb staying the same. It doesn't – here's why:

Whatever sorbent is used, there's a certain *heat of absorption* associated with the process. Temperature of the sorbent goes up and so does that of the air in contact with it. The air experiences both a sensible and latent heat gain from this source. Where final temperature as well as humidity is important, it is customary to follow up the dehumidifier with a cooling coil. This brings final temperature down along a constant dewpoint line.

Air Mixtures. In many air-conditioning systems, air returning from the conditioned space is mixed with incoming fresh air. It is thus important to know what happens when such a mixture takes place, and what the resulting condition is.

In the simplest case, Fig. 9, the conditions of one air are shown at point *A*, the other at *B*. Somewhere along a line drawn between them, at point *C* for example, we find the conditions of the mixture. Where point *C* falls depends on the percentage of each air in the mixture. If the mixture is a 50-50 one, point *C* will fall halfway between *A* and *B*. If the mix is ⅓ air *A* and ⅔ air *B*, point *C* will fall ⅓ of the way from *A* to *B*. This is what you would expect – it is natural that the conditions of the mixture would reflect the conditions of the largest component of it.



9 MIXING AIR AT DIFFERENT CONDITIONS

Sensible-Heat Factor. In practical air-conditioning work, the designer's problem is to select the supply air conditions that give the desired results in the conditioned space. Each such space presents a heat load of some kind – people, machines, lights, solar heat on walls, etc. Supply air must be able to pick up the load and still produce the conditions wanted.

Effect of picking up such loads is a gain in total heat of the supply air. Depending on the nature of the loads, this may come in the form of sensible-heat gain, latent-heat gain, or some combination of them. Ratio between the sensible heat and the latent heat gain is thus extremely important.

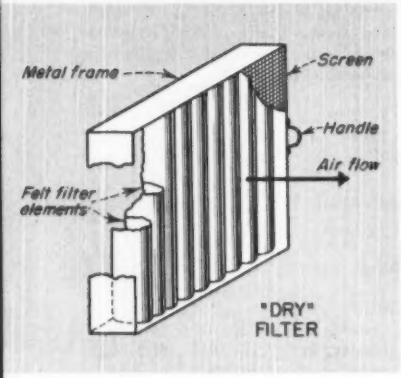
How It Works. To see why this is so, let's assume that we're delivering air to a conditioned space and that this air has, as a result of the conditioning method used, a relatively high moisture content. If the heat gain in the conditioned space is all sensible heat, we will probably wind up all right. Result of the heat gain will be a higher dry-bulb and lower relative humidity.

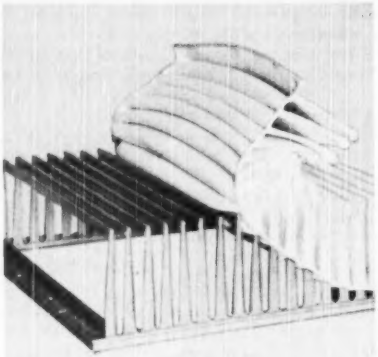
But let's assume it's the other way around, and we have a high latent heat gain. We'll wind up with room air that is saturated, or nearly so. It will certainly be uncomfortably humid. The answer, of course, lies in reheating the supply air before it reaches the conditioned space. This gives us a sensible-heat gain, pulls down the relative humidity, and puts the supply air in shape to handle the latent heat load of the space to be conditioned.

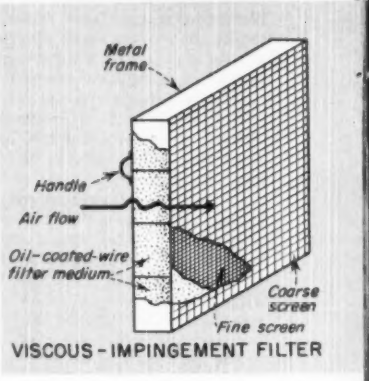
Figuring Heat Gains. Handbooks give the information needed to estimate sensible- and latent-heat gains. When these are known, the procedure followed to arrive at desirable supply-air conditions depends largely on which type of psychrometric chart is used for calculations. Without going into detail, most of these methods result in locating on the chart a *condition line*. Each point on this line represents a combination of dry- and wet-bulb temperatures for the supply air that meet the given heat-gain conditions. Important point is to select a combination that matches what the air-conditioning equipment is able to do. If the equipment selected cannot meet the supply-air conditions necessary, it must be modified, perhaps by addition of a reheating coil, or by some other change.

In the foregoing, we've hit the high spots of air properties and how they can be changed. Following pages show equipment available for the job, and how these devices are combined into working systems to meet the needs of various types of installations.

VARIOUS FILTER MEDIUMS SERVE JOB NEEDS, INCLUDE "DRY" UNITS...



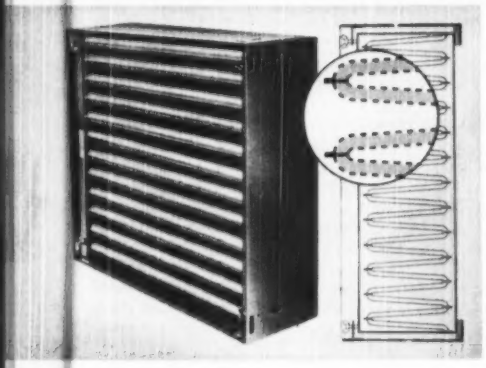


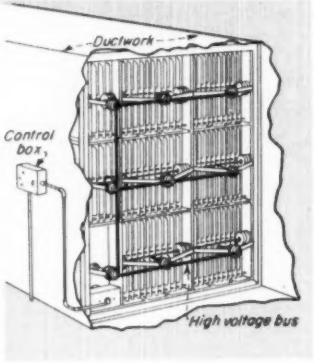


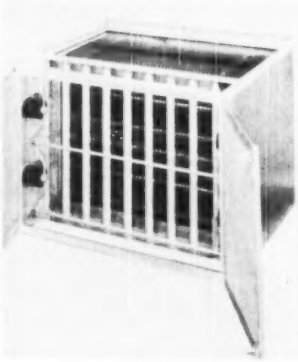
1 "Dry" filters act like fine-mesh screen to sift dust particles from air stream. Wool felt forms a common filtering medium; shown above is a design for easy cleaning

2 In viscous filters air passes oily fibers, dust is caught on the sticky surfaces

THESE CLEANING DEVICES HANDLE EXTREMELY FINE PARTICLES, ODORS







5 Objectionable odors and vapors can be removed by activated-carbon units placed in ductwork

6 Electrostatic precipitators remove extremely fine dust particles, pollen, and smoke. Viscous material on plates holds collected particles

Here Are the Tools . . .

To condition air completely, as we have seen, we must remove dust and other foreign matter, regulate temperature, control moisture content, and distribute air as needed. To this 4-part job we usually add another step—providing basic sources of heat (a boiler, for example) and of cold (refrigeration machinery). For these five phases of the over-all job we have a considerable variety of equipment – some familiar from heating and ventilating practice, some specifically developed for air-conditioning work. In the following pages, we'll take a look at typical examples of this equipment, passing lightly over the familiar devices and lingering longer on the specialized units applicable to this field.

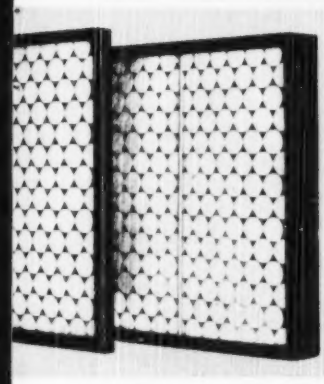
Cleaning

Virtually all air-conditioning systems bring in some fresh air to replace air allowed to leak out of the conditioned space. This outside air brings with it dust, pollen and other foreign matter. Furthermore, air that is recirculated may pick up dust, cigarette smoke, odors, etc. Thus our cleaning job may include both fresh and recirculated air, and removal of more or less tangible particles, such as dust, or microscopic particles of smoke or vapors. To some extent, then, the equipment used, and where it is placed in the system, depends on how much of this cleaning job we elect to do.

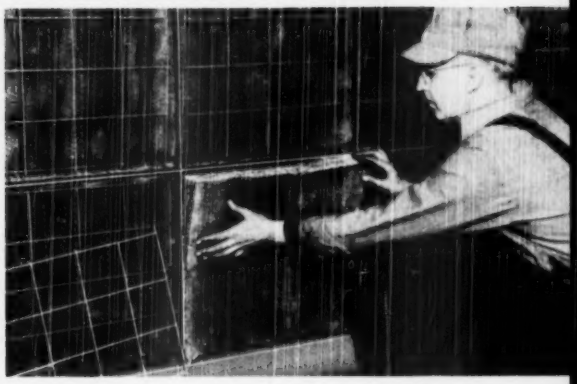
Devices that screen out particles by mechanical means are usually called *filters*. The ideal filter would (1) take out *all* dust particles (100% efficiency) (2) offer no resistance to air flow, and (3) need no maintenance. Selecting a filter for any given job involves balancing these several factors to best fit the particular conditions.

Filters may be divided into two broad classes: (1) *throwaway* units in which the filtering medium is made cheaply enough to be disposed of when

AND RECHARGEABLE CELLS USING VISCOUS-IMPINGEMENT PRINCIPLE



3 Filter medium for viscous units may be glass fiber, wire, crimped metal, packed closely and coated with sticky oil



4 When a cell becomes dirty it is taken out of the bank, replaced with a spare. It can then be cleaned and recharged

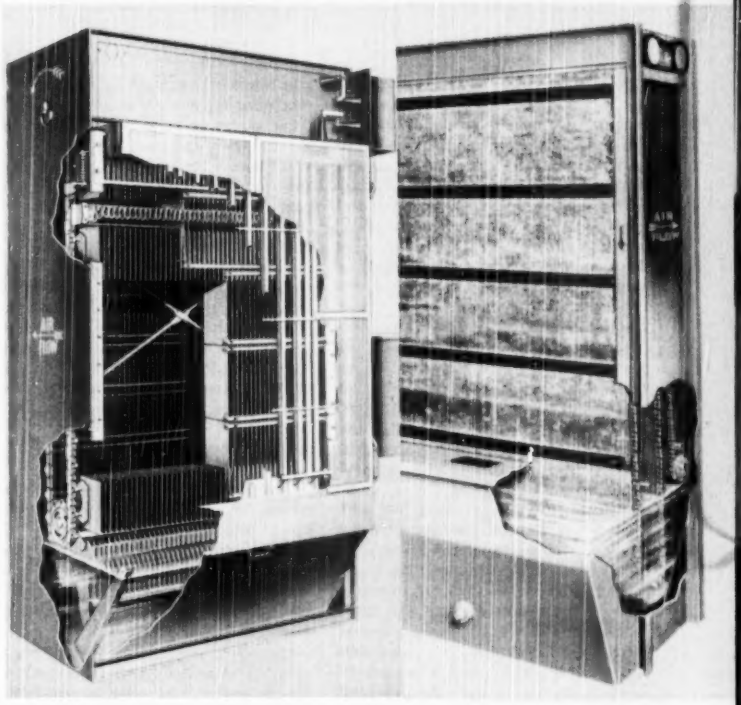
it is dust laden, and (2) *cleanable* types, which can be reused.

Dry Filters. Filters may also be classified by the principle they operate on. So-called *dry* filters "strain out" dust particles by forcing air to flow through a screening material, such as tightly woven wool felt, gauze, cellulose, etc. For throwaway use, filtering medium is cheap and the frame or holder is cardboard or other inexpensive construction. Type illustrated in Fig. 1 is cleanable. It uses wool felt, arranged on a metal frame to make maximum surface available in small space. Such units can be vacuum cleaned, air blown, or dry cleaned.

As a class, dry filters serve best for relatively small air flows and light dust loadings. They are highly efficient and, when clean, offer relatively little resistance to air flow. Resistance builds up rapidly, however, and dust-holding capacity is relatively small. Change in resistance usually indicates when filter should be replaced or cleaned.

Viscous Filters. In these units, air flows between tightly packed fibers or surfaces (glass wool, wire, crimped metal, etc.) which are coated with a sticky oil. Dust particles impinge on the viscous surfaces and are held. In most designs, filtering material is packed tighter in the direction of air flow, so air passages become progressively smaller, Fig. 2. With light, cheap frames, viscous filters may be used and thrown away. With more permanent constructions they are designed for cleaning and re-use. A typical installation consists of a bank of individual filters or "cells", Fig. 4. Cells may be removed from the bank one at a time and replaced with a spare. Dust-laden filter elements may then be cleaned and recharged with oil for further service.

CONTINUOUS SELF-WASHING FILTER DESIGNS

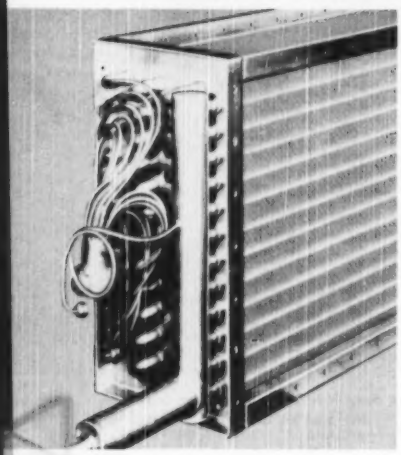


7 By moving filter elements through an oil bath they are continuously cleaned and recharged. Unit, *right*, uses viscous-impingement principle; *left*, electrostatic

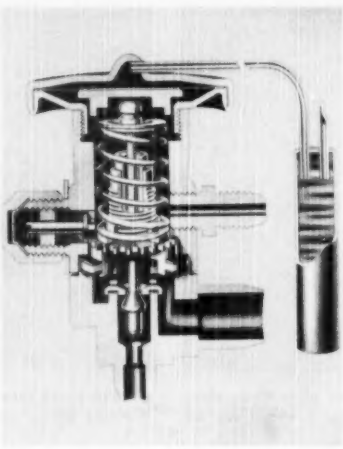
Initial resistance of viscous filters runs slightly higher than for dry filters, but rises more slowly in service. Dust-holding capacity is greater.

Self-Cleaning Filters. The viscous principle is often employed in filters that clean and recharge themselves continuously, Fig. 7. Filter elements, which may be like those in stationary units, Fig. 4, or may be perforated metal plates, are mounted on endless chain that moves intermittently. The

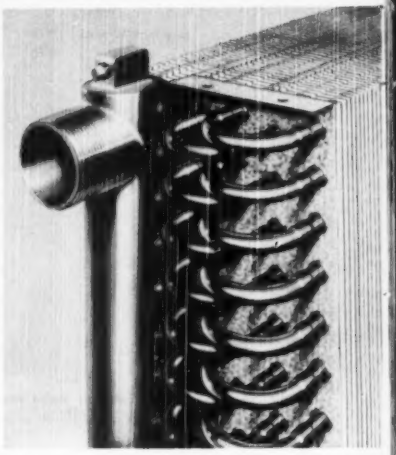
COOLING AND HEATING COILS MAY CARRY REFRIGERANT, WATER, OR...



8 Vaporizing refrigerant in direct-expansion coil abstracts heat from air



9 Thermal expansion valve controls the refrigerant's evaporation in the coil



10 This coil carries chilled water, a cooling medium used in many jobs

elements pass through an oil bath at the bottom of the unit. This cleans and recharges them. Such units offer a relatively constant resistance to air flow and require little maintenance except occasional scraping of sludge from the oil bath. Since cost of motor drive and control doesn't decrease proportionately as size of unit goes down, these designs usually prove economical on larger installations.

Electrostatics. Devices of Fig. 6 make use of the fact that a dust particle exposed to an electrical field assumes a charge and migrates to one of the electrodes. Pre-ionizing wires set up a high-tension field (around 12,000 v) through which air flows. Precipitation takes place in a lower-voltage secondary field of positive and negative plates set parallel to flow.

Usual design has plates coated with a viscous material to hold the attracted particles. When cleaning is needed, the unit is shut down, washed with water sprays and recoated. Electrostatic units are also built self-cleaning, Fig. 7.

Electrostatic precipitators are highly efficient on extremely fine materials and remove smoke and other microscopic particles beyond the reach of mechanical filters.

Odor Removal. Odors and objectionable vapors can be removed in several ways, adsorption being relatively common. Tubes or canisters filled with activated carbon are mounted in the ductwork with a filter ahead, Fig. 5. When the carbon has adsorbed up to about 20% of its own weight it must be reactivated.

Dusts, water-soluble gases and vapors may be removed by washing or scrubbing the air. *Air washers* serve as triple-threat units, being used also to control temperature and humidity. We'll take a look at them a little further along. Air *scrubbers*, as distinguished from washers, may be employed where it is desirable to reclaim dusts from air (industrial exhaust systems, for example). They consist of plate surfaces set in zigzag fashion with a water film running over them. Air must pass through narrow openings between scrubber surfaces. Solids left behind on them carry down to a settling basin out of the air stream. Such scrubbers also remove some gases and vapors.

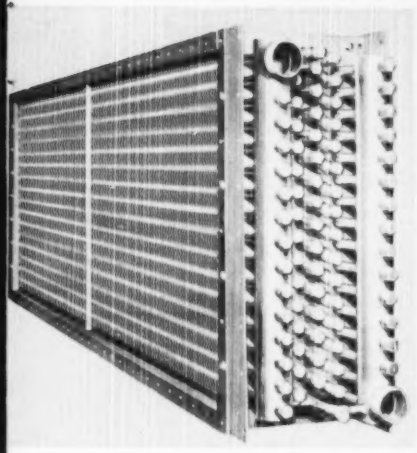
Heating, Cooling

Temperature control in a summer air-conditioning system involves cooling, of course, and usually some "reheating." In year-round systems, the heating function becomes equally important. Cooling medium may be chilled water, brine or refrigerant; heating medium may be steam, hot water, or, occasionally, refrigerant vapor. Heat transfer to and from the air stream may be *indirect*, by coils, or *direct*, by sprays, Fig. 12, or combinations. Spray scheme usually means an air washer, the triple-threat device mentioned before. Because it buttons up three jobs, we'll discuss it later.

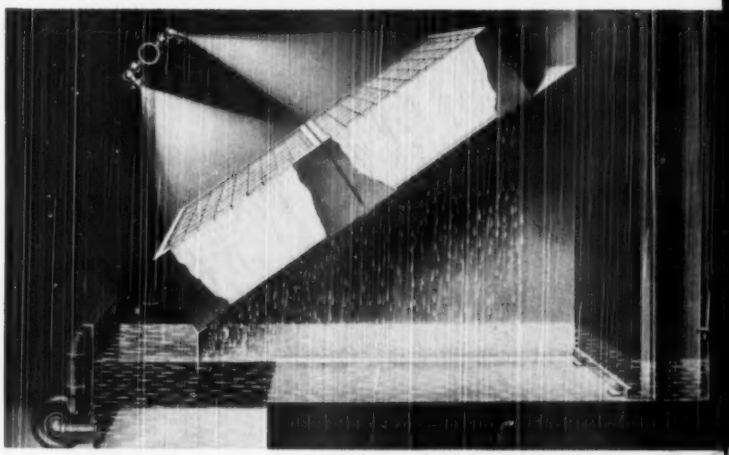
Here we're concerned with coils, which make possible a closed and balanced heating or cooling circuit. Since there is no contact between the heating or cooling medium and the air stream, we have freedom of choice and can, under some conditions, use refrigerant liquids and gases for the job. Coils used purely for heating resemble closely those described in "Building Heating," POWER, June 1949, pp 81, 82. Let's take a look at coils for cooling.

Direct Expansion. As permitted by local codes, certain refrigerants (Group I, American Standards Assn) can be used directly in the cooling job. In such *direct-expansion* coils, liquid refrigerant vaporizes and in so doing extracts heat from the passing air stream. This forms a simple and economical arrangement, particularly in smaller systems. Bear in mind, however, that these coils handle a volatile refrigerant, and so certain precautions must be observed. Coil should be uniformly and effectively cooled throughout, and the compressor protected from entrained unevaporated refrigerant.

There are two basic control methods for direct-expansion coils. The *flooded* coil (not widely used in air conditioning) has a small surge tank. A float keeps liquid refrigerant at desired level in both coil and surge tank. *Thermal-expansion* valves, Fig. 9, are commonly used. Such a valve feeds just enough liquid to the coil to hold refrigerant at coil's suction outlet at about 6-10 F superheat. This is measured by a temperature bulb, which actuates the valve. It is usual practice to get this superheat within the coil so coil length is selected with this in mind. Every effort is made to hold pressure drop in the refrigerant circuit at practical levels. This may require more than one refrigerant feed per expansion valve. When several feeds are used, a dis-



11 Where solids in water may plug coil, user may want clean-out type



12 A spray of cold water played across the path of the air stream can be used to cool it down; in addition it sets dewpoint for control of the air's humidity

tributor divides refrigerant equally between feeders.

Chilled Water. More common practice, particularly in larger installations, involves indirect cooling by means of chilled water. Refrigerant expansion and consequent cooling is done at a central point, and actual cooling of the air stream is handled in coils carrying chilled water. Because temperatures below 40 F are rarely needed, water can do the job; brine is seldom used.

Since refrigerant expansion occurs outside the air stream, choice of refrigerant becomes wider. Piping for chilled water being relatively easy to install, such systems prove flexible in layout, well suited to large jobs.

Coil Construction. Chilled-water coils usually have nonferrous tubes, often with extended surface, Figs. 10, 11. Extended surfaces may be staggered or in line with air flow. Plain tubes are used where frost might accumulate.

Coil performance depends, among other things, on the way air flows over outside of tubes in relation to the way the heating or cooling medium flows inside them. Steam-heating coils, in which temperature within the tubes is practically uniform, are usually installed for cross flow of air. With chilled water in the coils, however, counterflow (water flow opposite to air flow) is almost universal. This gives highest mean temperature difference for entering air and water temperatures.

For much the same reason this scheme is used in coils fed with refrigerant. The higher entering-air temperatures help superheat the leaving refrigerant gas. With deep coils, however, the parallel-flow method (water flow in same direction as air flow) is used from the second row back. Circuit is completed by returning through the first row to get desired superheat from the higher air temperature there.

Moisture Control

Important in the air-conditioning job is control of moisture content. Adding moisture is called *humidification*, and taking it out, *dehumidification*. Sometimes only one or the other of these operations is involved, but in most air conditioning we want to *humidify* at times and *dehumidify* at others. The *air washer* serves this purpose in many systems, along with cleaning the air and heating or cooling it. Let's look now at this multipurpose device and see how it works.

Air Washers. In essence, an air washer consists of a casing with one or more spray banks through which air flows. Usually there is some sort of eliminator at the outlet end to remove any entrained moisture from the leaving air. Spray water collects at the bottom. In passing through the sprays, air may be heated or cooled, humidified or dehumidified, depending on water temperature and the air's dewpoint, wet-bulb and dry-bulb temperatures.

As a starter on air-washer operation let's assume we're going to recirculate the spray water. When air and spray water come in contact, a heat exchange takes place — air gives up some of its sensible heat to vaporize some of the water. Thus its dry-bulb temperature is lowered. And with an increase in moisture content, dewpoint temperature rises. If those changes aren't entirely clear, refresh your memory on air properties by turning back to the first part of this special section.

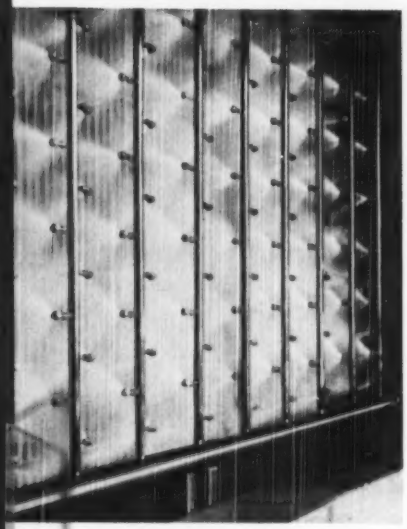
At the beginning, water temperature changes also, rising toward the wet-bulb temperature of the air. After a short time, operation levels off and water temperature stays constant.

Washer Effectiveness. If the air washer were perfect, here's what would happen: wet-bulb temperature of the air would be unchanged, while dry-bulb would drop down to equal it, and dewpoint would rise to equal it. Water temperature would also level off at this point. Thus the air would have been cooled and humidified.

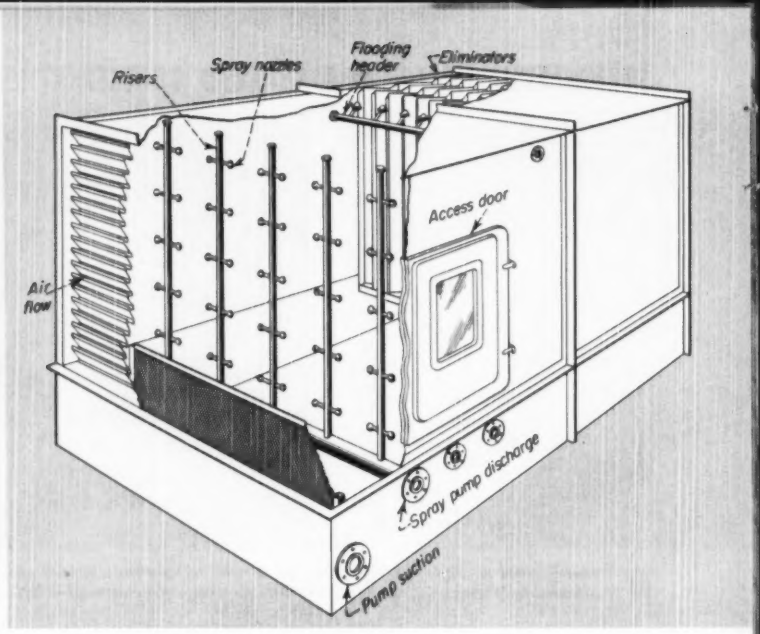
Since the washer's operation is not perfect, the dry-bulb and the dewpoint only *approach* the wet-bulb. How close this approach is may be used as a measure of the washer's effectiveness. It depends on the unit's general design and particularly on the number of spray banks. For a close approach two or more banks are needed.

This recirculation-type of operation is useful, but it's limited. By controlling water temperature we can fix the air conditions the washer produces. This means either blending fresh water into the washer circuit or passing the recirculated water through a heating or cooling coil outside the washer. Since the operations we're going to talk about involve heat transfer from air to water or water to air, water temperature will change during the process. What we're concerned with is the *final* water temperature; or the initial tem-

WASHER CONSTRUCTION



13 **Main air stream passes through air washer, gets moisture content set**



14 **Washer may have one or more spray banks, *left*. Supply header delivers water to risers and nozzles; spray saturates air so it nears wet-bulb temperature**

perature and flow needed to hold it.

Washer Operations. Without going into detail, we can summarize possible washer operations as follows: (1) If final water temperature is held above entering-air dry-bulb temperature, we get both heating and humidification. (2) If we hold final water temperature below the entering-air dry-bulb, we get cooling and humidification. If water temperature stays below air wet-bulb, the same thing is true, and both dry-bulb and wet-bulb temperatures are lowered. (3) If we hold final water temperature below air's dewpoint, we get cooling and dehumidification.

Thus through the use of air washers we can exercise considerable control over the temperature and moisture content of the air. The necessary control of water temperature can be effected in any one of three ways: (1) recirculating only part of the spray water and adding to it hot or cold water as needed (2) pumping the water through a heating or cooling coil outside the washer, or (3) mounting a heating or cooling coil directly in the air-washer sump. In either (2) or (3) all water is recirculated.

Washer Construction. A basic need in any air washer is intimate contact between air and water. In most washers, Fig. 13-15, this is secured by breaking up water into small droplets in spray nozzles, like Fig. 16. Number of banks of sprays depends on the effectiveness desired; for dehumidification, two or more spray banks are usually installed. For good performance, air velocity through the washer chamber should be moderate (350-600 fpm), and there should be ample length of travel through spray zones. Effective moisture eliminators at the outlet end are essential.

Another means of securing intimate contact between air and water lies in use of wetted surfaces. Washer of Fig. 12 uses the capillary action of glass filaments to distribute thoroughly water sprayed across the surface. Air passing through the thoroughly soaked mass of glass fibers comes in close contact with the many wetted surfaces. This construction yields improved cleaning action, somewhat like that of a viscous filter.

Surface Humidifiers. In small installations and in room coolers, the pan-type humidifier may be used. Steam or electrically heated tubes in the bottom of the pan heat the water for vaporization. The air stream sweeping over the pan carries the moisture off with it.

Direct Humidification. Increasing humidity by adding moisture to the air stream on its way to the conditioned space is called *indirect* humidification. It is usually employed where humidity control is part of an over-all conditioning problem, as in the usual comfort system. In industrial applications, textile mills for example, a high relative humidity may be what's needed, with temperature control and ventilation only incidental. For such conditions, *direct* humidification — adding water directly to the air in the conditioned space — is often economical.

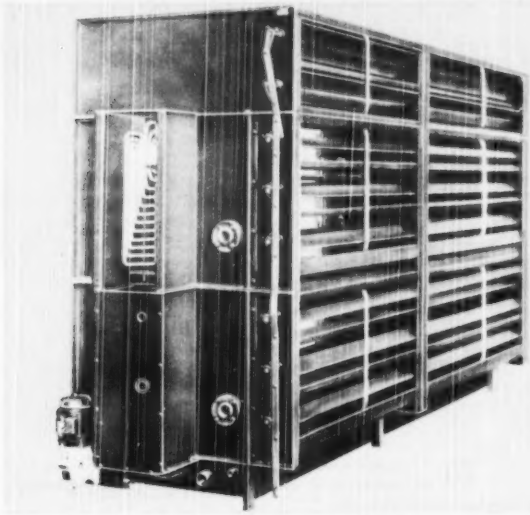
Nozzles for atomizing water so it can be readily converted to vapor by room heat may employ compressed air to aspirate water to the nozzle and atomize it, or may use air pressure in combination with water pressure. Such nozzles are located around the conditioned space.

In so-called high-duty humidifiers, water at high pressure (about 150 psi) passes through an impact-type nozzle mounted in a cylindrical casing. A fan above the unit forces air through it. This air, cooled and charged with moisture, escapes from an opening below, at high velocity and in a nearly horizontal circle. A somewhat similar design eliminates the fan. Aspirating effect of the spray nozzle induces an air flow through the casing. This helps to distribute the spray.

Working without compressed air, pumps or other auxiliaries, the centrifugal humidifier, Fig. 17, both generates and distributes the necessary fine spray. It is thus often called a self-contained humidifier.

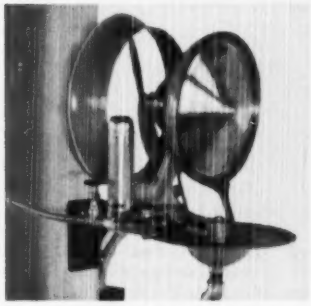
Dehumidifying. There are basically two ways to dehumidify air: (1) cooling, and (2) chemical adsorption. Let's look at the cooling angle first. In talking about air washers, we saw that if final water temperature held below the initial dewpoint of the air, we got both cooling and dehumidification. We can see that the same result could be pro-

WATER SPRAYS SERVE FOR HUMIDIFYING AND DEHUMIDIFYING



15 Air washers for dehumidification have at least two banks of sprays, Fig. 13. When used with direct-expansion cooling coil, spray water is all recirculated

16 Spray nozzles in risers discharge at from 1¼ to 2 gpm each into air



17 Centrifugal humidifier delivers fine spray into the conditioned room

duced if we cooled the air by heat transfer to a coil carrying chilled water or expanding refrigerant, as long as coil temperature is below dewpoint.

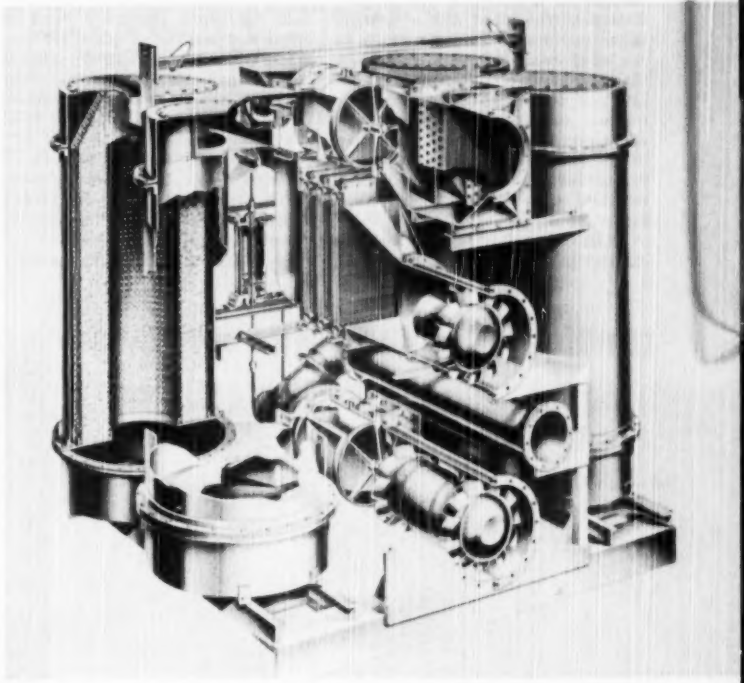
Cooling coils designed for dehumidification should have finned surfaces separated enough so moisture condensing on them can roll off. Drip pans and drains should be provided for the condensate. Since the air stream may pull condensed moisture off the coil surfaces, there should be some form of moisture eliminator on the discharge.

Whether a spray device, such as an air washer, or a cooling coil should be used for any given cooling and dehumidifying job depends on a variety of factors. In general, washers find use in the larger central systems, while the compact coils are widely adopted in unit or packaged air conditioners, and in small systems.

Dehydration. Dehumidifying, without removing heat at the same time, is sometimes called *dehydration.* In such an independent dehumidifying operation, latent heat in the entering air is converted into sensible heat in the leaving air. The job is done with *sorbents,* materials having the ability to extract and hold water vapor from surrounding air. Sorbents may be divided into two classes according to the way they behave in use: *adsorbents* do not change chemically or physically in the process, while *absorbents* change either physically, chemically, or both.

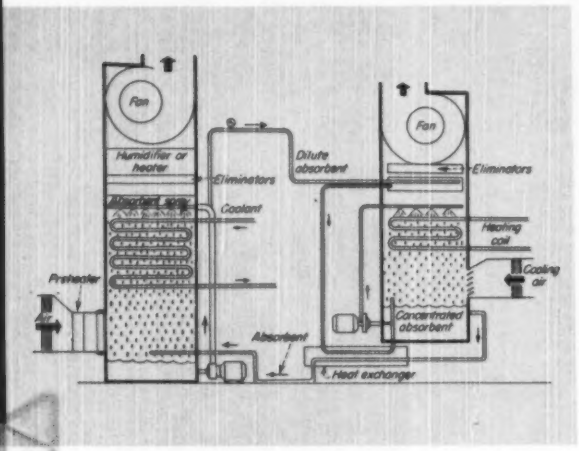
Solid Sorbents. Typical adsorbents are solids — activated alumina, silica

MOISTURE MAY ALSO BE REDUCED BY SORBENTS

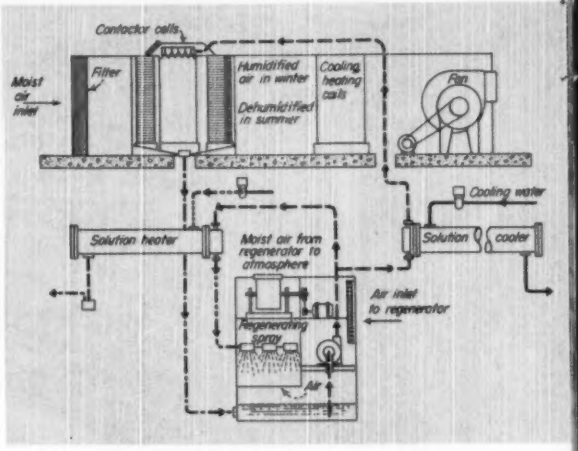


18 Solid sorbents, in this case silica gel, remove water from air if vapor pressure in sorbent is below that of air. One bed is reactivated while other works

THESE DEHUMIDIFIERS USE LIQUID SORBENTS TO REGULATE MOISTURE



19 **Tower, *left*, fixes moisture content of conditioned air; *at right*, sorbent gives up water and is reconcentrated**



20 **Pump draws sorbent from regenerator: about 85% goes to cooler, spray nozzles; rest is reheated, concentrated**

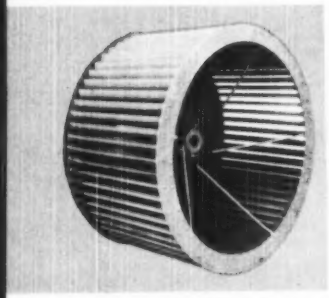
gel, activated carbon, bauxite. These remove water from an air stream only if vapor pressure of the water in the adsorbent is less than the partial pressure of the water vapor in the surrounding air stream. In other words, the process is primarily one of condensation. The latent heat of vaporization and heat of adsorption have to be taken away by the surroundings. Thus the air stream, the adsorbent itself, and the adsorbent container, all increase in temperature. Eventually the sorbent temperature reaches a state of equilibrium and the material has to be reactivated — heated to drive off the adsorbed moisture and cooled down for re-use.

Usual equipment for solid sorbents employs a single or dual bed depending on how important it is to maintain continuous dehumidification. In small installations, and where a short-time outage for reactivation is not too important, the single-bed units may be used. Fig. 18 illustrates a typical dual-bed arrangement for continuous operation. Air enters through a bank of filters and reaches an adsorbent bed. While this bed is working the other is being reactivated — heated to about 300 F. Heating may be done by steam coils, electricity, waste flue gas from gas or oil fires.

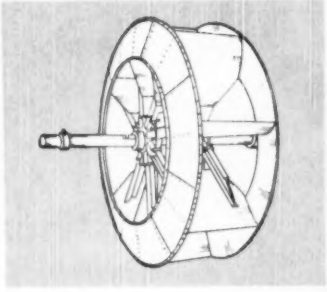
Liquid Sorbents. Typical absorbents are liquids — solutions of the halogens (lithium-chloride, calcium-chloride and lithium-bromide) and the glycols (mostly ethylene, diethylene and triethylene glycol). These solutions must have concentrations such that their vapor pressure with respect to water is lower than that of the water vapor to be removed from the air. In the typical liquid-sorbent equipment, air passes through a tower into which the liquid sorbent is sprayed either in a fine mist or as a blanketing solution on the tower surfaces. Again, differences in partial pressure determine the absorption. Soon a state of equilibrium is reached. The sorbent solution, the air, and the equipment increase in temperature as latent and chemical absorption heats are taken up.

The warm, weak sorbent solution is first cooled. Then part is diverted for concentration. This is done by heating to a vapor pressure well above that of air blown over it; water in solution

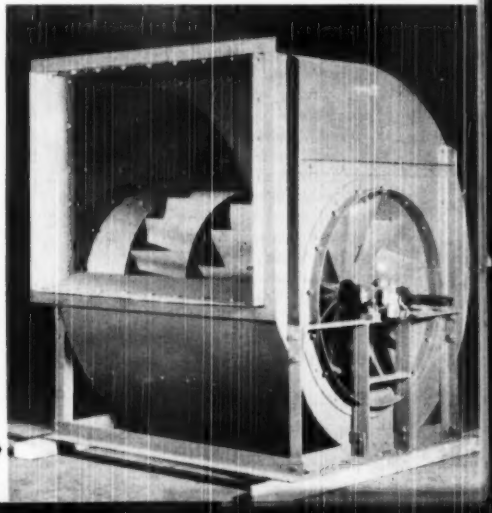
CENTRIFUGAL FANS FIND WIDE APPLICATION



21 **Typical multiblade wheel for centrifugal fan unit**



22 **So called "plate" construction may also be used for centrifugal wheels**



23 **Inlet vanes iron out turbulence in the air stream and decrease noise**

goes off with the air. After cooling, the concentrated solution rejoins the main stream to maintain proper density, the principal factor determining water absorption by liquid sorbents. Fig. 19 and 20 show typical equipment for dehumidification by use of liquid sorbents.

Chemical dehumidification finds use primarily where moisture removal is the major consideration. Where sensible as well as latent heat must be removed, chemical units may be combined with cooling equipment. Whether such a combination works out better than the conventional cooling-dehumidification depends on a number of factors. Conditions favoring use of chemical dehumidifiers are: (1) availability of cheap cooling water for sensible heat removal (2) cost of gas or steam low in relation to cost of electricity, and (3) load that is mostly latent heat.

Air Distribution

Having cleaned our air, and adjusted its moisture and temperature, our next job is to move it to the points where it is to be used and to distribute it in the conditioned spaces in the proper amounts and without drafts.

Air movement begins with fans. They develop the necessary pressure head to overcome resistance to air flow. Then we have ducts — trunk ducts and branches — for guiding air to its destination. Finally we have outlets, grilles, registers, diffusers for introducing the air into the conditioned space.

Fan Types. Air-conditioning fans may be divided into two groups: (1) the familiar *centrifugal* designs, whose flow is essentially at right angles to the axis, and (2) *axial* designs, whose flow is parallel to the axis.

Typical centrifugal fan consists of a wheel with blades at its rim, the whole rotating within a housing shaped like a scroll. Shape and direction of the blades has a great deal to do with fan performance. There are three basic types: (1) forward-curved blades have the tip inclined in the direction of fan rotation (2) radial-curved blades have a straight, radial tip, and (3) backward-curved blades have tips inclined opposite the direction of rotation.

Each of these blade shapes produces distinctive performance characteristics. The forward-curved blade is widely used in air-conditioning and ventilation because it: (1) is more compact for given air delivery and static pressure, and (2) operates at lower tip speed and is thus apt to be quieter. Backward-curved type operates at relatively high speed but has steep pressure curves and non-overloading power characteristics. It is well adapted for direct motor drive and for systems in which demand fluctuates widely.

In the form of the "propeller" fan, the axial type is familiar for applications where pressure is relatively low. Recent designs of axial fans will deliver against pressures as high as 9 in. of water, making them suitable for working with some duct systems. As a class, axial fans have high efficiency and non-overloading power characteristics. Because of the straight-through flow, they offer possibilities of ductwork simplification.

System Load. When you put together the necessary ductwork, heating and cooling coils, filters, etc that make up an air-conditioning system, you have set up a fan load that is highly individual to that system and to which the fan must be matched. The resistance a system offers varies nearly as the square of the air volume flowing through it. When you superimpose system and fan characteristic curves, operation is at point common to both.

Ductwork. When it comes to sizing ductwork, it must be kept in mind that type of equipment as well as its purpose influences the air-transmission system. For instance, in some systems, air is moved at high velocities to save ductwork costs and space. In others, lower velocities may prove desirable.

Ducts are usually made of galvanized steel, frequently a copper-bearing alloy for corrosion resistance. Insulation may be desirable on long runs and where heat pickup may be large. There are also prefabricated duct sections of laminated asbestos, Fig. 27.

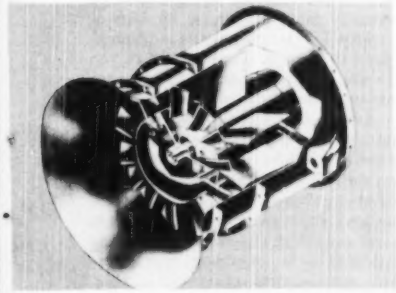
Air Distribution. Securing proper distribution of air within a large room without creating drafts is difficult. Any air movement at a rate above 30 fpm in a room of seated people may seem uncomfortable to many. If the temperature and relative humidity are within comfort-zone limits, somewhat higher velocities can be tolerated. And where people are moving about, velocities as high as 120 fpm can be used. Air can be withdrawn through grilles at up to 70 fpm without discomfort.

Over and above precautions taken to prevent undue drafts is the desire to get even distribution despite the fact that incoming air may be different in temperature from the room air. Furthermore, some means of controlling air quantity at room inlets may be desirable. Thus a considerable variety of grilles and diffusers are available, Fig. 28-31, incorporating features designed to solve these problems.

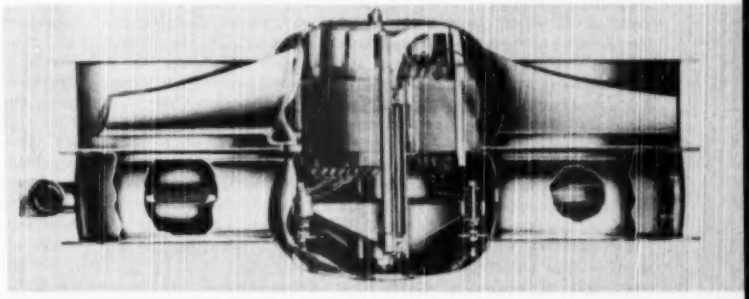
Refrigeration

In the foregoing, we have talked of heating and cooling operations without reference to the source of heat and "cold." For heating, of course, we use some form of steam or hot-water boiler. Such heat sources are covered in

AXIAL FANS MAY SIMPLIFY INSTALLATION OF DUCTWORK IN FAN ROOMS

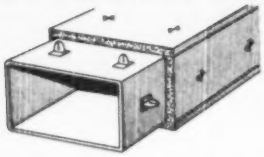


24 This axial fan has adjustable inlet blades to compensate for resistance

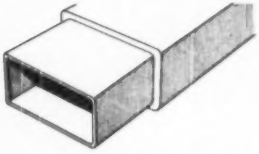


25 Large air volumes can be moved against relatively high resistance with axial fans; design shown above has motor built into the hub, relatively short blades

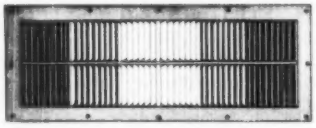
DUCTS DELIVER AND OUTLETS DISTRIBUTE AIR



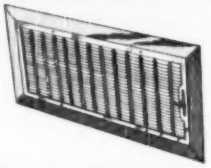
26 Ducts, commonly made of galvanized steel, may need insulation



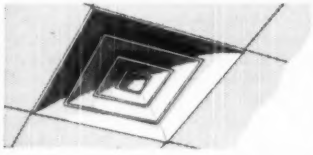
27 Ducts may also be prefabricated of laminated asbestos, as shown above



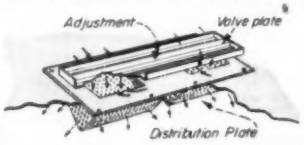
28 Grille has deflecting vanes so any desired air pattern can be set up



29 An adjustable damper permits varying the volume of entering air



30 Latest diffusers mount flush with ceiling, blend with the decorations



31 Valve plate and distribution space slow air down, smooth out the flow

POWER's special sections "Steam Generation" (Dec 1946) and "Fuels and Firing" (Dec 1948). Here we propose to concern ourselves briefly with sources of cooling, leaving detailed treatment to a future special section on refrigeration.

Cooling Sources. In some cases, water may be available from natural sources (wells, for example) at temperatures low enough for use in an air-conditioning system. Where well water cannot do the job by itself, it may serve for part of the job — precooling, for example. In most cases, cooling must be provided by refrigeration machinery.

Most refrigeration systems depend on the fact that vaporizing a liquid requires a relatively large amount of heat and the further fact that the temperature at which vaporization (and the reverse operation, condensation) takes place depends on pressure. By juggling these factors, we can vaporize our *refrigerant* and extract heat at some low temperature, and can condense it back again at a higher temperature. This means that we can do the cooling needed for condensation with, for example, water at readily available temperatures — say 70-80 F.

Compression Cycles. In the most familiar type of refrigeration, we use some form of mechanical compressor to make the pressure changes we need. In such a cycle, Fig. 32, we work with a refrigerant that boils or vaporizes at a relatively low temperature. Allowing this liquid to vaporize in an *evaporator*, or direct-expansion coil, extracts heat from the surroundings. We then take refrigerant gas at low pressure and compress it to a higher level — high enough so that water at some handy temperature, say 80 F, will condense it back to the liquid form.

The essential parts of a compression system are thus a compressor, a condenser, a receiver for storing liquid refrigerant, an expansion valve, and an evaporator or expansion coil. Compressors may be of reciprocating or centrifugal design, usually driven by motor, sometimes by a steam turbine or an internal-combustion engine. Condensers in modern plants are usually of shell-and-tube construction. For capacities up to about 100 tons of refrigeration, so-called condensing units are available. These combine the compressor, condenser and receiver in a package, sometimes hermetically sealed.

For reciprocating compressors, the most widely used refrigerant in air-conditioning work is Freon-12. Ammonia offers many thermodynamic and practical advantages and is used widely in industrial applications where economy is important and precautions can be taken against the hazards of ammonia's toxic properties. Methyl chloride finds uses in smaller units. Carbon dioxide, while considered a "safe" refrigerant, is not often used today because the required high pressures mean heavy equipment and high power consumption.

Centrifugal compressors, suited, in general, for lower operating pressures, often use Freon-11, which has desirable pressure characteristics.

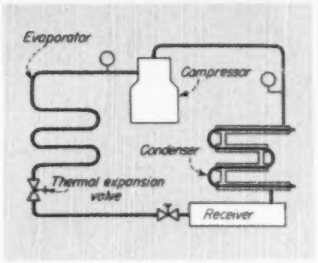
Steam-Jet System. Although we do not usually think of it, water may be used as a refrigerant. It is, in itself, cheap, and completely safe. Because extremely low pressures (actually high vacuums) are needed, the usual apparatus employs steam ejectors. Fig. 33 shows such a system. In the evaporator, which is under high vacuum, part of the water flashes into steam, cooling the rest of the water. To maintain the vacuum, ejectors draw off the vaporized water and entrained air and compress them to a higher absolute pressure. The compressed vapor and the "power" steam are then condensed. This condenser requires considerably more cooling water than the condenser for a conventional mechanical compression system, since it must remove the heat of the power steam as well as that liberated from the chilled water. Such systems find use where condenser water is plentiful and steam cheap.

Absorption Systems. In these systems, heat is used in place of mechanical work for changing refrigerant pressure. The compressor is replaced by three devices: an *absorber*, a *pump* and a *generator*, Fig. 34. After expansion in the evaporator, the refrigerant goes to the absorber and is taken up by a low-temperature absorbent fluid This solution is pumped to the generator, where heat is supplied to drive off refrigerant as a gas. This is condensed to a liquid, as in a mechanical system, and goes to evaporator for expansion.

Absorption systems of the past used ammonia as refrigerant, it being readily soluble in water. Other combinations have been employed, particularly in gas- or oil-fired domestic refrigerators. A recent development uses lithium-bromide salt and water, with water acting as the refrigerant. The boiling point of the salt, a solid at ordinary temperatures, is so high it behaves like a non-volatile substance. There is thus no vaporization of the absorbent in the generator and no carryover of the absorbent vapor to the condenser. The characteristics of the absorption cycle limit its usefulness to places where sources of heat and cooling water are plentiful and cheap.

Ice Systems. Some installations, such as churches and theaters, have short operating hours and relatively high peak loads. Investment in mechanical refrigeration equipment would thus run high. In some such cases, ice proves the answer. A comparatively small quantity of ice in the water-

VARIETY OF REFRIGERANTS AND REFRIGERATING SYSTEMS AVAILABLE



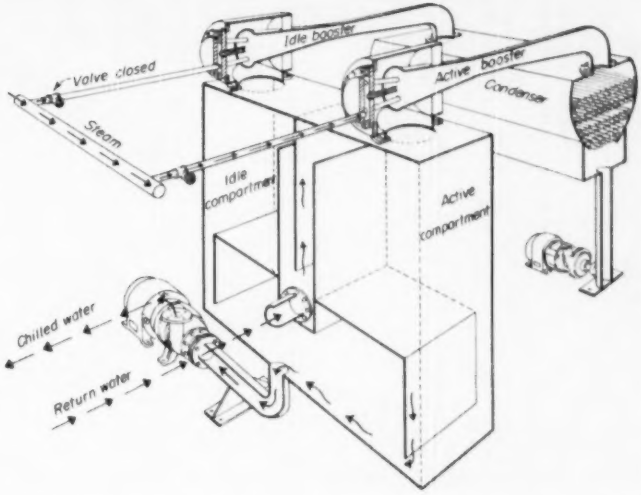
32 Diagram shows elements of familiar compression refrigeration cycle

cooling tank of such an installation, Fig. 35, can release refrigeration at a rapid rate.

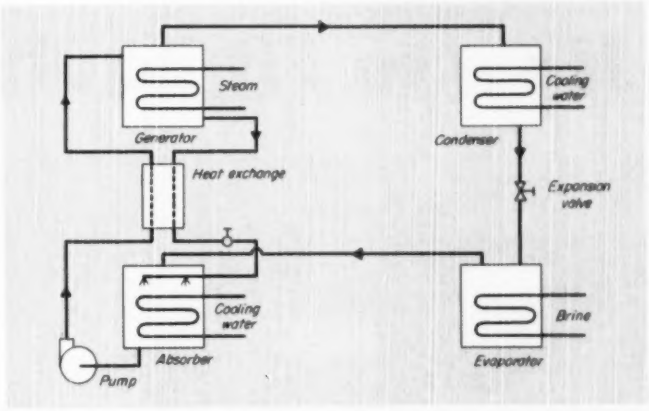
Cooling Water. Virtually all refrigeration systems require water for condensers. For a fortunate few, natural water supplies—wells, rivers, lakes, etc.—are available. In many areas, however, public water supplies must be used. Both for reasons of cost and, in recent years, increasing shortness of supply because of skyrocketing demands, conservation is essential. This leads to use of some form of evaporative cooling, in which air does most of the work and water consumption is sharply cut.

Cooling ponds and spray ponds are seldom used in air conditioning. Cooling towers and evaporative condensers prove the usual answer. In essence, a cooling tower consists of a casing which may be filled with spray or with a packing over which the water falls in thin films. The objective in either case is to bring about intimate contact between water and air passing through the tower. Evaporation of a small part of the water, say about 5%, cools the rest. Some towers are of the atmospheric type, using natural draft; most, however, employ mechanical draft, either forced or induced. This yields a more compact and efficient tower. The water to be cooled may be run through the tower, or may pass through a heat exchanger cooled by the tower water, which is recirculated. Larger towers are usually installed outdoors, frequently on building roofs. Smaller towers are designed in some cases for indoor installation.

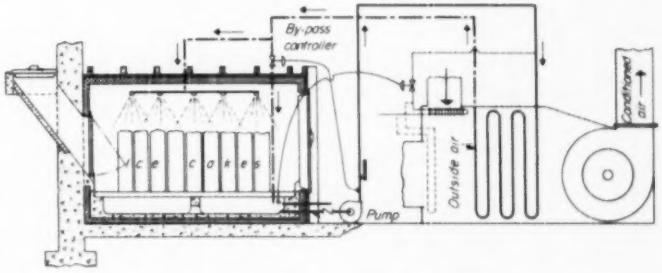
The evaporative condenser consists of a steel casing housing coils over which a water spray falls. A fan forces air through the casing at high velocities. Evaporation of part of the water removes heat from the fluid in the pipe coils. This may be condenser water but usually refrigerant gas itself passes through the coils.



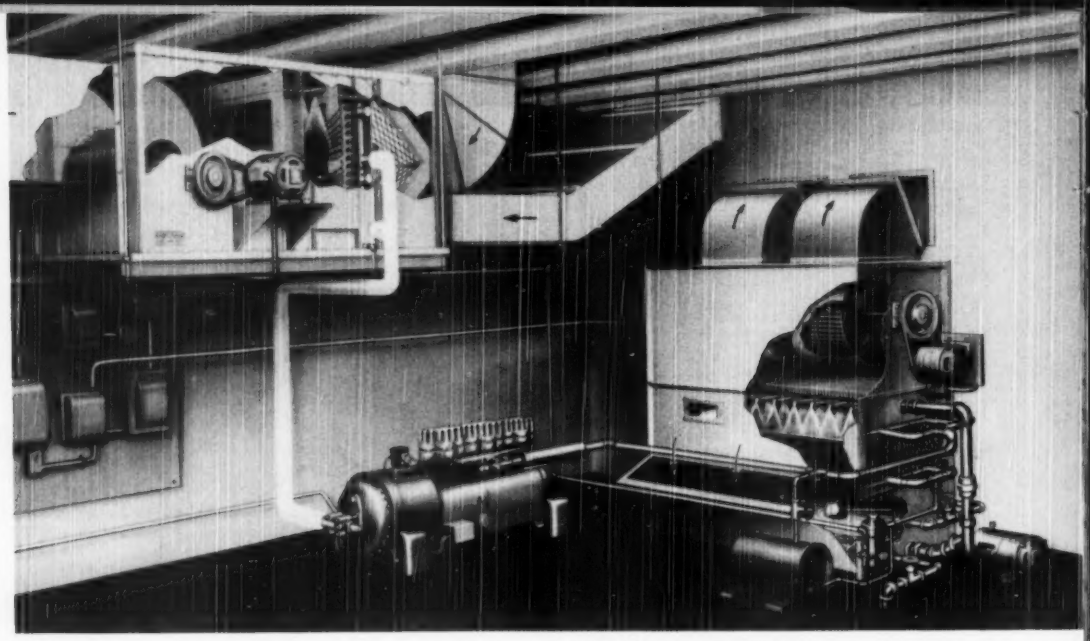
33 In steam-jet refrigeration system, water is really the refrigerant. Ejector establishes vacuum, causing part of water to vaporize; this chills the rest



34 Absorption system of refrigeration uses a low-temperature liquid to absorb vapor from the evaporator; refrigerant is boiled off in the generator section

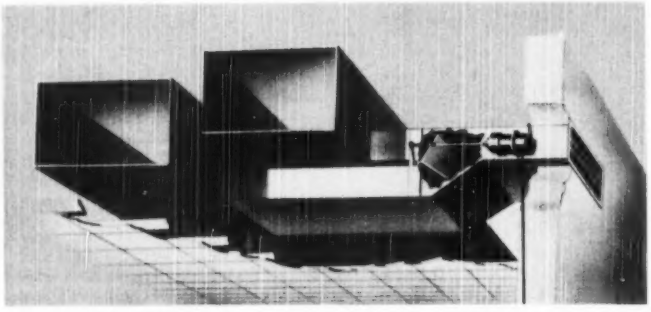


35 Cooling job can also be handled by melting ice. Melted ice and a controlled quantity of spray water circulate through the cooling coils in the air stream

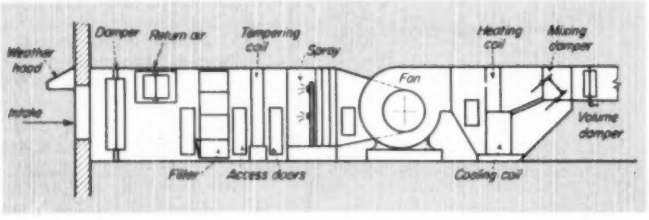


1 Central system using a remote apparatus room for all the elements involves low investment where air-conditioning load is high. Maintenance and inspection can be carried out with least disturbance to occupied zones; space costs little

How to Fit Equipment to



4 Double-bladed mixing damper in takeoff from two separate ducts, one carrying cold air and the other hot, blends air to give the desired room temperature



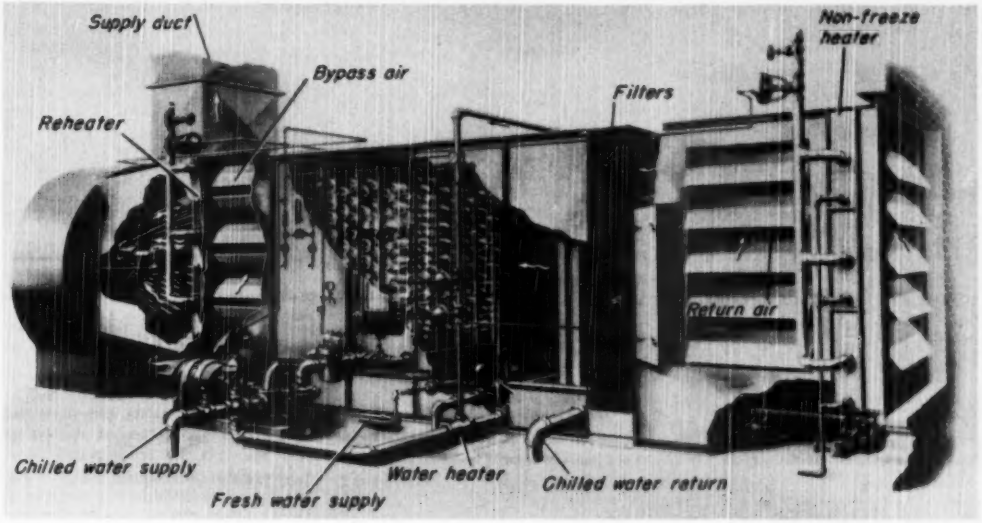
5 For use with the control setup shown in Fig. 4, this central system supplies conditioned air at one temperature to one duct, at lower temperature to other

Up to now we've talked about the things that make air conditioning possible — the properties of air and the tools available for putting these properties to work. We're now ready to button up the story by showing how the various elements may be combined to meet the needs of different jobs.

Behind each choice of a combination is the question, "What arrangement gives the most economical answer?" In larger plants, some form of central system may pan out best; for smaller setups, there are packaged units and room conditioners. In some buildings, air conditioning combines with an existing heating plant, with the heating equipment handling the "cold-wall" load of outside walls and windows. This so-called "split" system has also been used in a number of new buildings, employing radiant heating in walls or ceilings. In a couple of current cases, radiant coils will carry some of the cooling as well as the heating load.

Central Systems. In the true central system, all major equipment — filters, air washer, fans and refrigeration machinery — are centrally located, removed from the area to be conditioned. Ducts distribute conditioned air to the various occupied spaces. Advantages claimed for such a system include:

CENTRAL PLANT DELIVERS CONDITIONED AIR THROUGH DUCT SYSTEM



2 Central plant, above, shows all the conditioning elements needed for central air distribution except refrigeration

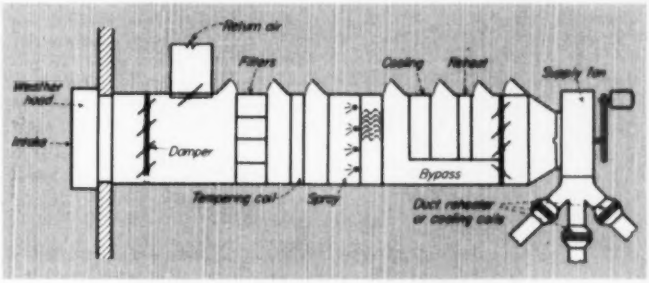
3 Conditioned air from central system, below, is delivered to zones by separate ducts, with reheat or cooling coils

the Job

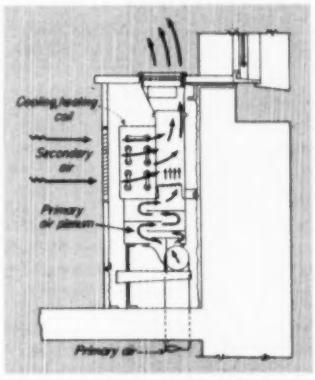
(1) It occupies space of relatively little value compared to conditioned areas. (2) Where the air conditioning load is fairly large, investment cost may be less than for other possible arrangements. (3) Maintenance and inspection are carried on with little disturbance in conditioned areas. (4) Exhaust air can be returned and partly reused with obvious savings in heating and refrigeration.

Major drawback to such a system is the space taken by ductwork, often impossible to secure in existing buildings. Ductwork is also expensive. This leads to modified forms of the central system. In the commonest of these, refrigeration and heating is handled centrally, and the cooling and heating mediums distributed to local conditioning equipment serving individual floors or areas.

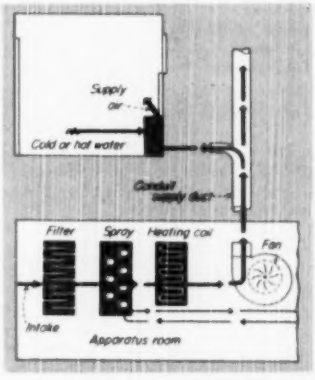
Typical System. Fig. 1 shows a typical central-system apparatus room. Large duct, *upper right*, carries incoming fresh air. Ductwork coming down from upper floors brings back return air. Air from these ducts meets and mixes in proportions regulated by mixing-damper setting. Air then passes through a filter bank and back over direct-expansion coils. These coils both cool and dehumidify. Right behind



HIGHER AIR SPEEDS PERMIT SMALLER DUCTS

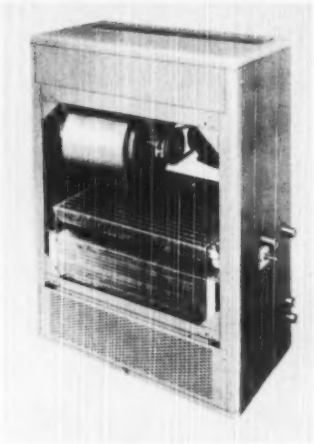


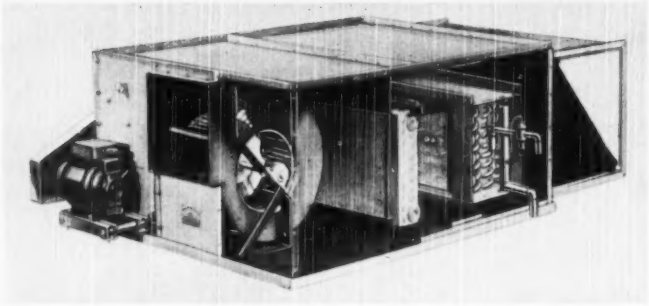
6 Room convector takes high-velocity air, mixes with room air as needed



7 Supply and return distribution system for room convector shown, *left*

SUPPLIED BY A CENTRAL PLANT, THESE UNITS HANDLE LOCAL AREAS

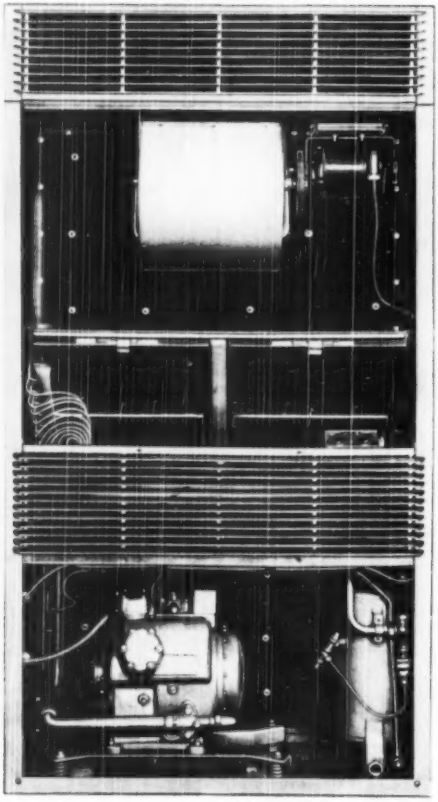




8 **Packaged air-conditioning assembly, *above*, is complete except for refrigeration. Such units serve as air-distribution centers supplied by central refrigeration**

9 **Smaller unit conditioners of same principle as Fig. 8 design, *left*, may be spotted through the plant. Need only electricity, air and refrigeration connections**

PACKAGED CONDITIONING EQUIPMENT



10 **Complete air-conditioning assembly, including refrigeration, gives central system in packaged form; may carry floor load in old building, save supply duct**

them is a spray system for further adjustment of moisture content. In winter, when moisture must be added to the air, the spray does the job. A reheat coil follows, to set final relative humidity and meet variations in sensible-to-latent-heat ratio.

Along the right wall is an evaporative condenser for the refrigeration unit (*center*). Note that air supply and exhaust for the evaporative condenser are entirely separate from air supply for the conditioning system.

Larger System. A somewhat larger plant shows in Fig. 3. It draws in outside air from the left, preferably from an intake on the building side least exposed to solar heat, and not too close to the ground or a roof. A proportioning damper interlocks with a damper in the return duct to control ratio of fresh to return air. Usual scheme is to key these dampers so, as outside air increases, return air decreases, and vice versa. Then the mixed air streams pass through a filter bank.

Cleaned air is then ready for temperature- and moisture-control stages. Systems using air washers, see Fig. 2 also, usually pass air over a tempering coil to make sure its temperature is above freezing point. During most of the operating time, enough return air goes back with the incoming fresh air to avoid any freezing in the washer. This unit serves as a spray humidifier in winter months, and may be used as a dehumidifier in summer.

In the layout of Fig. 3, air from the tempering coil goes directly into the washer for humidification as needed. After the washer there are cooling and reheating coils, with a bypass around them into the main supply fan. Note

provision for reheating or cooling coils in branch ducts.

Fig. 2 shows a practical arrangement of the air-conditioning elements—tempering coils, filters, washer, etc. It delivers conditioned primary air for distribution through a central duct system.

Zoning. In a large structure, such as an office building, hotel or industrial plant, conditions vary from one part to another. Air conditions that are right on the sunny side, for example, are wrong for the shady side. Thus areas are usually broken up into zones, each fed by separate ducts. A number of different means are used for supplying correctly conditioned air for the various zones.

One scheme would be to regulate quantity of conditioned air entering a given zone—that is, proportioning the flow according to the different zone loads. But the control mechanism—usually throttling dampers—presents some problems and this method is not generally recommended.

Booster Heaters. A better hookup uses properly proportioned heating and cooling coils (Fig. 3) in branch ducts leading to individual zones. These are supplied from the central heating or cooling equipment. With these heaters exact adjustments in dry-bulb temperature can be made for each zone.

In a variation of this system, each branch duct has a separate small supply fan, with the reheating and cooling coils on the suction side. These fans should be of backward-curved non-overloading design so they won't tend to fight each other for the air supply and upset air distribution.

Blending Air. Fig. 4 and 5 show another arrangement. Supply fan is right behind the air washer, which is bypassed in hot weather. Supply fan discharges through a split duct. The top part has a heating coil, the lower, a cooling coil. Air leaving these coils goes into separate chambers, with branch ducts running from them. "Hot" and "cold" ducts run side by side. At each takeoff there is a double-bladed mixing damper under control of a room thermostat or other control device. This blends warmer and cooler air as needed to give desired conditions in each occupied space.

In the particular system shown, the cooling coil carries no refrigerant in winter, and the heating coil no heat in summer. Since the air leaving the warm chamber may be high in relative humidity it may not compensate for the nearly saturated cool air. Closer control over relative humidity may be obtained by a reheater in the cold-air chamber for summer service.

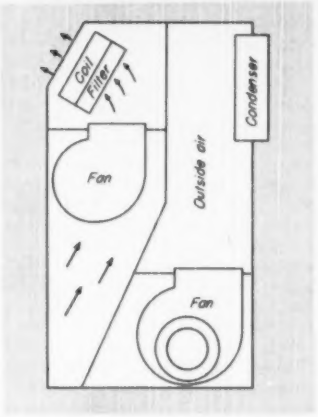
Booster Fans. In a widely used hookup, there is a booster fan between main air supply and each occupied zone. There is no return of air to the central conditioning equipment, which handles all fresh air. A takeoff with a double mixing damper connects each booster fan and the main duct. This mixing damper interlocks with an outlet exhaust damper in the return-air plenum for the zone. As more zone air is recirculated and the main air duct supplies less, exhaust damper closes in proportion so less air spills to waste. Thus local recirculation and mixing effect control.

In many hotels and offices, the booster-fan system serves individual floors as separate zones. The fan itself is usually in a fan room off the main corridor, which serves as a return-air plenum.

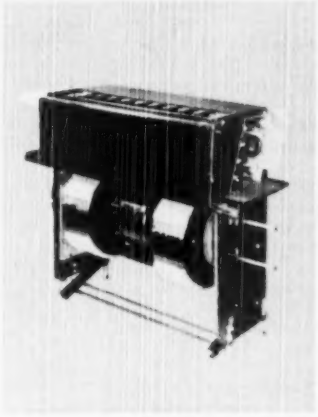
High-Velocity System. For economy of space and installation cost, one system distributes conditioned air at high velocity through relatively small conduits. These serve what might be called induction convectors in each conditioned space. The high-velocity conditioned air, Fig. 6, acts as a jet to induce room air to mix with incoming conditioned air. The mixture sweeps over a heating or cooling coil for final conditioning. Water supply and return lines supplying these coils parallel the air conduits, which are furred-in along outside walls.

Same induction principle is applied in smaller buildings, using supply and return ducts instead of high-velocity conduit. Both sensible and latent-heat cooling is done centrally. Control of summer room temperature is accomplished locally by regulating amount of conditioned air admitted to the induction convector. Convector unit has a heating coil for winter operation.

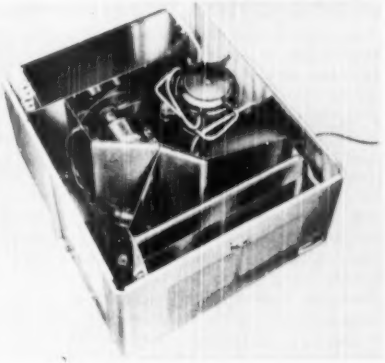
Package Conditioners. Recent years have seen the development of packaged systems for smaller installations. A typical unit, Fig. 10, contains in its



11 Floor model has refrigeration, conditioning equipment on inside



12 This room air conditioner depends on an outside refrigeration supply



13 Complete, self-contained window units require only an electrical plug-in to go to work. Usual design has the conditioning elements inside, refrigerating outside

housing all essential elements for conditioning — refrigeration machinery, filters, cooling coils, fan and mixing plenum. Only connections needed are for water, drainage and electricity.

Such packaged conditioners may stand in the conditioned space, or serve a small duct system connecting several areas. Used in sufficient numbers, they meet the needs of existing buildings where installation of a conventional central system might be difficult or expensive. They prove an ideal answer, of course, for small buildings, stores, isolated spaces, etc.

Local Conditioning. In one of the most widely used modifications of the basic central system, only the refrigeration is handled at a central point. Chilled water or refrigerant for cooling, and a heating medium if needed, are circulated throughout the building instead of conditioned air. Actual work of conditioning is handled locally, usually on each floor of a multi-story building. At each such point there is a "fan room," containing fresh-air intake, filters, washers, coils, etc. Each such fan room supplies a duct system for its own floor, with the usual supplies and returns.

While the local conditioning equipment may be assembled for the individual job, it is also common practice to employ packaged assemblies like Fig. 8, 9. Each such unit acts as a separate air-distribution center for its own area. The packaged assemblies greatly simplify installation and reduce cost. Unit of Fig. 8, designed to hang from the ceiling, contains filters, a direct-expansion coil, spray nozzles for humidification, a reheating coil and a fan. Similar models use chilled water for cooling. Unit of Fig. 9 fits smaller jobs and is designed for an exposed location where appearance may be important. It may also be obtained with cooling coils designed for either refrigerant or chilled water.

Room Conditioners. Unit of Fig. 9 might properly be called a "room" conditioner. But we apply the term here to equipment in which the refrigerating elements are closely associated with the others and which are suitable for use in relatively small spaces, such as individual offices, hotel rooms, etc. There are two broad types of room conditioners — floor and window models. Many floor models have all the equipment inside the conditioned room, Fig. 11. Refrigeration condenser is usually air cooled — in this case by a short duct taking outside air through the window opening. Only about 6 in. of window height is needed for this.

Some floor models, Fig. 12, have refrigeration equipment outside the unit itself, in a nearby closet, for example. If this can be done, it tends to yield quieter operation. Since there is no flow of condenser air through the unit itself, any moisture condensed on the cooling coils must be carried off in a drain. It is customary to locate such a conditioning unit near a window so it can be used for ventilation by drawing in fresh air from outside.

Window models, like Fig. 13, are usually complete unit air conditioners designed for mounting in a window opening. The low side, consisting of an evaporating coil, circulating fan and filter, usually is on the room side of the window line. The high side — compressor, condenser, and its cooling fan, extend outside. This simplifies the air cooling of the refrigeration equipment. Such units are extremely easy to install, requiring only electrical connections.

Reversed Operation. Room conditioners with the refrigeration equipment inside the room may be used to provide some heating in winter months. The cooling coil becomes the condenser and the condenser acts as an evaporator. This is, in effect, the basic principle of the heat pump. Operated in this way, the unit abstracts heat from the outside air and delivers it, at a higher level, to the room. Outside air temperature has to be at least 45 F for satisfactory reversed-cycle operation of this kind.

As the name implies, room conditioners are primarily intended to serve a single, relatively small space. Hence they usually discharge directly into the space, without ductwork for air distribution. Some room air is mixed with outside air; usually a damper arrangement is provided for control.

System Selection. As the foregoing pages indicate, there are many answers to the individual problems of different types of buildings. Much depends, of course, on the size and type of building and whether it is to be air conditioned throughout. For small buildings, and for conditioning of isolated spaces in large buildings, room or unit conditioners may prove the answer. In larger buildings, where a complete job is involved, much depends on whether conditioning equipment must be fitted into an existing building. With a completely new building considerable freedom of choice is possible.

In existing buildings, the problem of finding space for ductwork may prove the vital factor. Lack of space points to use of a high-velocity conduit system or to the circulation of chilled water with local fan rooms serving individual spaces. In high buildings, the duct problem is likely to be acute, and so the alternatives prove attractive. If vertical zoning is used, with a fan room on each floor (a common scheme) care should be taken to seal off each floor from the others. If this isn't done, cool air tends to migrate to lower stories and warm air to upper.

Type of occupancy and amount of individual control required determines to a large extent (1) the degree of zoning on a horizontal basis and (2) the most suitable of the several methods for controlling distribution to zones.

ACKNOWLEDGMENTS

For preparation of this section, considerable general information and specific technical data were made available by manufacturers in the air-conditioning and allied-equipment fields. POWER wishes to acknowledge its debt to the following for their help and cooperation:

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1 Oswego's control room for two single-boiler-turbine units has proved itself in ten years of service. Rooms such as these are bringing about a realignment of conventional operator duties. Many will do both mechanical and electrical chores

Why Use Centralized Station Control?

Designers tell why station-control layouts result from more than personal preference. Vital cost comparisons include savings in operating labor versus investment in and maintenance of added instruments

► AT ITS WINTER MEETING in New York, American Institute of Electrical Engineers devoted one session to advantages and disadvantages of centralized station control. Program centered on these four papers:

Centralized Instrumentation and Controls for Steam Electric Power Stations, B C Mallory, Stone & Webster Engrg.

Design and Operation of Central Control Room, B F Borgel, Pa. Electric Co.

Central Control Desirable for Single Boiler Turbine-Generators, J A Lind & J M Geiger, Niagara Mohawk Power.

Centralized Control in Central Western Power Stations, J M Drabelle, Iowa Electric Light and Power Co.

This topic is particularly pertinent during the current wave of station installations. Nearly every conceivable arrangement can be found, from complete centralization to almost-complete decentralization of instrument and control boards. Designers must have reasons for choosing from this wide variety of layouts. Let's listen to what they have to say.

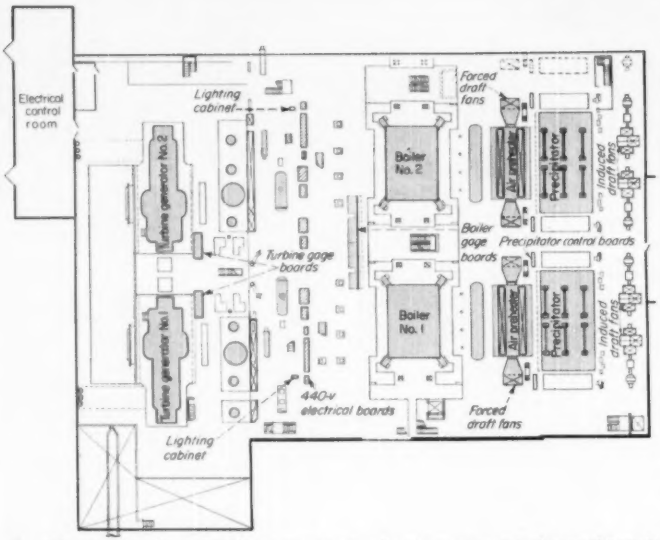
B C Mallory: On the surface, the ideal would appear to be the central station that one man could operate. All he would do would be to adjust load controls in response to load dispatcher's orders. This ultimate is neither feasible nor economical today.

Once started and on the line, a station may run automatically. Equipment and controls, however, are not sufficiently troublefree to run without adequate attention. Automatic controls are not available to start high-pressure boilers or turbines without careful checking and assistance from operators. Increasing costs of operating labor lead to centralizing controls to minimize the number of men needed. For medium-to-large boilers and turbines each control point may require an instrument and control board up to 30 ft long. Each panel becomes quite complex in appearance with literally hundreds of items—indicators, recorders, controls and alarm lights. Assembling several of these boards needs considerable space.

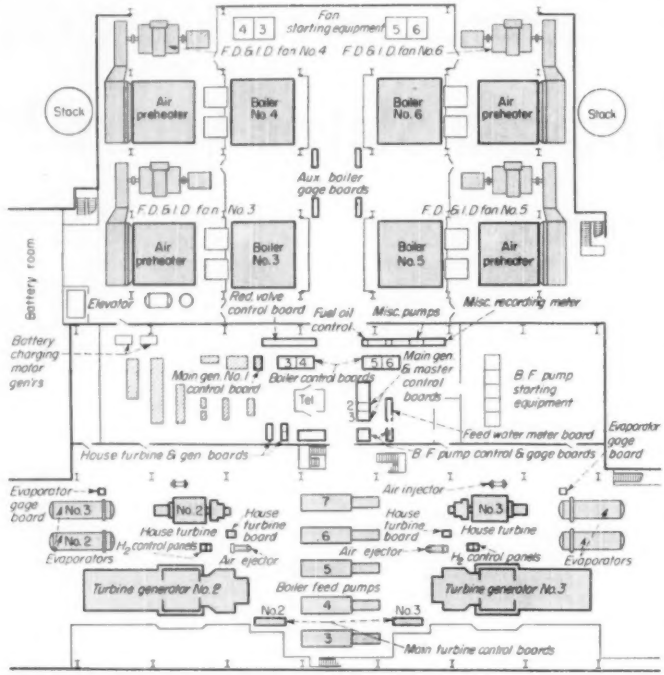
The practicality of centralization depends on the number of manual controls that one man can handle in time of trouble. Logical arrangement and varying control-handle shapes increase the number that can be handled safely. Layout should make routine adjustments a matter of habit and require only a minimum of thinking by the operator during emergencies.

Too often artistic appearance and space needed in back of panels for instruments has governed board layouts. We need miniature mechanical instruments comparable to those on electrical boards and large airplanes. For operating ease and reliability, instruments and controls should be segregated to permit adjusting vital controls from a central point. Minor manual controls and recorders should be at some less strategic location.

Centralized control offers these ad-



2 This operating-floor plan shows more conventional arrangement of control boards near equipment; high-tension control room, upper left; auxiliary boards, center



3 Centralized-control arrangement in this plant reduces operating crew to seven men per shift. Control-room operators handle both mechanical, electrical boards

vantages: (1) Reduces operating labor. (2) Making all data available to one operator gives a better understanding of a plant as an integrated unit. (3) Operator can make more than one adjustment simultaneously when needed. (4) Avoids communication errors. (5) Improves operation by higher-type personnel; higher thermal efficiency, better load control during upset conditions, quicker load restoration after interruption, better judgment in preventing an interruption. (6) More automatic control utilization frees operator from details, thus permitting better supervision.

Disadvantages of complete centralization are: (1) Space needed in heart of station adds to building space. (2) Each extra instrument and control adds to maintenance load and is potential source of trouble. (3) Requires a considerable training period for operators. (4) Adds cost of duplicating controls and longer runs of instrument and control leads. (5) Pay rate is higher for operators having greater responsibility.

Fig. 2 shows an essentially decentralized arrangement that one station owner prefers. His argument is that boiler and turbine operators are not readily interchangeable, duties being entirely different. In some localities, the union requires each boiler and turbine operator to have a helper, so centralizing control boards will not decrease operating labor costs.

Fig. 3 shows the operating floor of a plant extension with two 1300-psig 950-F 100,000-kw turbines and four boilers. A complete centralized mechanical and electrical control room stands at the crossroads between boiler and turbine rooms. In addition, there are additional gage boards at the equipment.

The 40x130-ft control room has 378 annunciator drops. This utility soundproofs only the telephone room, preferring to have its operators noise conscious in respect to the plant. Seven men per shift are expected to operate this station.

Many of the advantages of a centralized control room may be gained and some disadvantages eliminated by a centralized point for each single-boiler-turbine control between the two elements. Electrical controls, on the other hand, should be in a separate control room for all units in the station.

B F Borgel: Central-control room in the Warren plant of Pennsylvania Electric Co has enough instruments to give the operator a full picture of plant conditions at all times and full control of equipment during emergencies. Control room, Fig. 5, has equipment for (1) operation of boilers, generators and auxiliaries (2) indicating and recording supervision of turbines, hydrogen systems and feedwater systems (3) annunciator alarms on equipment, such as water screens, service pumps, storage-tank levels, air compressors, etc.

Plant has operated since Aug 15, 1948. Experienced operators were placed in the control room and green men without previous experience manned all other posts. No misoperation has resulted to date. During startup, the

plant had 17 trip-outs from staged relaying tests and accidental causes. The plant was always replaced in service and fully loaded within less than five minutes. Best record was 1 min, 30 sec.

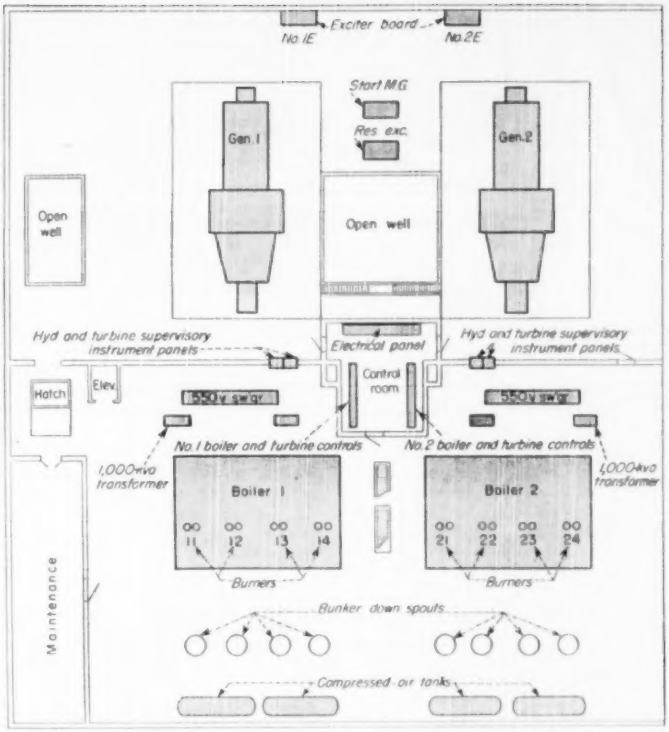
These trip-outs were duplicated in another plant identical to Warren but without a central control room. Restoration to service took a minimum of 11 min.

Experience with the present control room has led to projecting changes that will be incorporated in future installations: (1) Concentrate only those instruments needed for minute-to-minute operation on board fronts. Unless these fronts permit normal coverage by one operator, advantages of central control are lost. This principle would shorten the Warren boards by 30%. (2) Relocate hydrogen panel next to actual equipment. This will help local operator make needed adjustments, and avoid hazard of hydrogen leakage in control room. (3) Use pressure-transmitting devices with the sender at original pressure point. Use multiple-indicating units in control room and other locations. This avoids danger of pressure blowout in control room. (4) Apply phase-angle control of tieline loading and frequency to combustion control as well as turbine governor. A primary element on the combustion control will respond to phase-angle magnitude and a secondary element to header steam pressure. (5) Arrange the control room so its operator can see plant equipment. (6) Restudy high-intensity control-room lighting to avoid reflections in windows overlooking equipment.

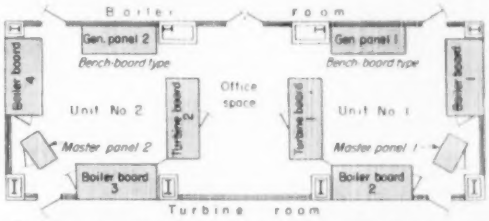
Warren, consisting of two 30,000-kw units, needs six operators per shift. Total force includes 53 men. Accurate cost data show the central-control room entails an additional investment of $60,000, or $1.00 per kw. Direct operating savings consist of elimination of two shift operators, amounting to $35,000 annually. No evaluation has been made of the return from faster and more efficient operation, but the amount has been sizable.

Lind and Geiger: Fig. 4 shows the operating floor plan of Oswego Station of Niagara Mohawk Power Corp. Central-control room stands between two single-boiler-turbine units. Fig. 1 shows the control boards in this room. Glassed areas overlook parts of the boiler and turbine room. A mirror near a furnace door checks proper ignition of furnace lighters and burners. Other mirror systems give visual indications of bi-color gage glasses.

Electrical control board at far end of Fig. 1 has the usual switchboard controls and meters. Mechanical-control boards, one for each unit at the sides, hold instruments, meters, gages and



4 Oswego's operating-floor layout indicates why a centralized-control room cannot conveniently handle more than two single-boiler-per-turbine units in one station



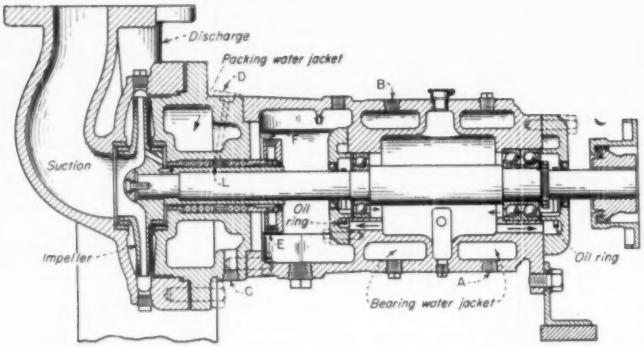
5 Warren's central-control room for two units does not give operators direct view of equipment they are supervising

controls for boilers and turbines. Panel size has been kept down by bringing only essential elements into the control room. For example, at each boiler feed pump there is a panel with flowmeter, pressure gages, pushbuttons for auxiliary oil pump, recirculation-control relays, thermometers, etc. In the control room there are only an ammeter, control switch, air-control subpanel and a telemetered flow indicator in a multiple-draft-gage type instrument.

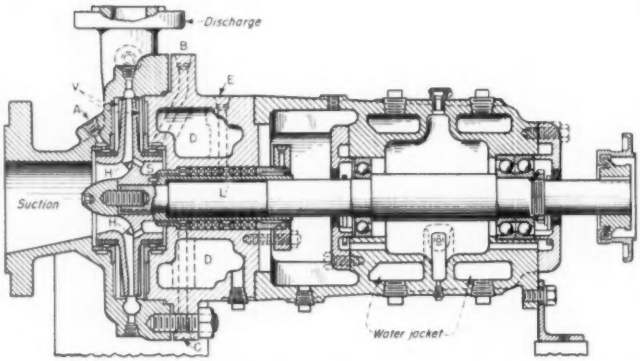
Control room is air conditioned. Operators communicate with auxiliary operators by either telephone or public-address system. Many abnormal operating conditions are indicated by an annunciator. Control-room operators directly control principal auxiliaries. For the most part these are started and stopped manually, but automatic speed and throttling control is provided. Related instruments and controls are grouped.

Some functions are handled on a plant basis rather than a unit basis. For example, (1) coal handling to bunkers of each unit (2) slag removal from boiler ash hoppers (3) flyash re-

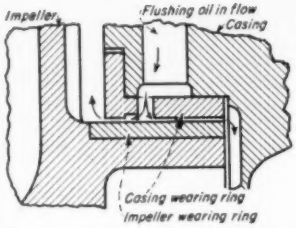
(*Continued on page* 184)



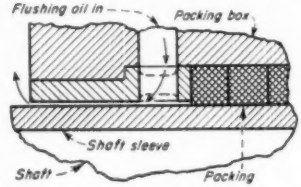
1 In this single-stage hot-oil pump the two bearings and the stuffing box are watercooled. The packing is both cooled and lubricated from a lantern ring



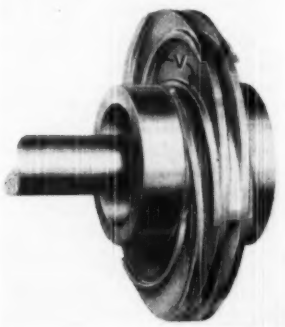
2 Pump designed to handle abrasive liquids has its wearing rings arranged for flushing with clean fluid. Holes through impeller keep packing pressure low



3 Cross section through wearing rings on the back of the impeller, Fig. 2



4 Cross section through the throat ring of centrifugal pump, Fig. 2



5 Impeller pump-out vanes keep solids from between impeller and casing

Centrifugal Pumps Designed for Tough Operating Conditions

When pressures and temperatures are high and the pumped fluid is abrasive, flushing and cooling the pump's parts often solves the difficulty. Here are some pointers on doing the job successfully

By JOHN J COFFEY, *Engineer, Pacific Pumps, Inc*

► A CENTRIFUGAL PUMP in its simplest form has rotating impeller and shaft, also, stationary element that includes casing, stuffing box, bearings. But depending on the liquid handled, its temperature and pressure, certain refinements must be added to the basic elements for satisfactory operation. These include provisions for cooling water, gland and flushing oil.

Cooling Water. Parts that may require water cooling are bearing housings, stuffing boxes, smothering glands and bearing pedestals. Housings of the thrust or line bearings are generally water jacketed, Fig. 1, when heat gen-

erated in the bearings cannot be readily dissipated to atmosphere. This heat is carried away by circulating water or some other cooling medium through the jacket around the bearings. Since the line bearing takes radial loads only and the thrust bearing both radial and axial loads, the latter is the bearing more frequently water jacketed.

Many pumps handle high-temperature liquids. Under these conditions heat may reach the bearings by conduction along the pump shaft or by radiation. So it is necessary to increase cooling water through the housing.

Stuffing Boxes. Heat is produced in a stuffing box by friction between the rotating shaft and stationary packing held against it. When a low-specific-gravity liquid is pumped, packing pressure on the shaft is increased to seal against its leakage. This increases temperature in the packing box. To remove this heat and reduce the explosion hazard, the packing box should have a water jacket, through which cooling water is circulated, Fig. 1.

Regardless of the specific gravity of the pumped liquid, it is good practice to water-jacket the stuffing box if pumping temperature exceeds 250 F. Jacket water reduces temperature of the liquid reaching the packing and also temperature around the latter.

Smothering Gland. Pumps sometimes handle liquids that are heated above their flashpoint or vaporizing temperature, such as liquid hydrocarbons. Stuffing-box leakage of these liquids or their vapors to the surrounding atmosphere cannot be tolerated because of possible injury to operating personnel or the explosion hazard.

A watercooled stuffing box tends to cool and condense leakage. When this external cooling is not enough, water may be circulated through the channel between packing gland and shaft sleeve, entering at *E* and leaving at *F*. The water and leakage by the packing combine to lower temperature of the mixture, causing it to condense and be absorbed or smothered in the water. When the packing gland is constructed as in Fig. 1, it is known as a smothering gland, quenching gland or gland snuffer.

Cooling Features. All cooling applications described are used on the pump in Fig. 1, which is designed to handle hot oil. For cooling the bearings, water enters at *A*, flows through the water jacket and out at *B*. Oil rings circulate the oil through the bearing, as indicated by the arrow below each. This oil carries heat from the bearings into the reservoir. Then cooling water flowing through the water jacket picks up heat from the oil and takes it away.

Stuffing box is cooled by water entering at *C* and leaving at another connection not shown. Water flowing through the jacket picks up heat from the packing and cools it. Thus, packing temperature is kept within safe limits.

Bearing Pedestals. A centrifugal pump expands as temperature of the material handled increases. High pumping temperatures distort the pump shaft because of temperature differences along its length. To prevent misalignment of the pump with its driver, pedestal supporting the hot end should have cored passages for circulating cooling water to reduce the pump's temperature and expansion.

When hot refinery liquids are pumped, clean, cool oil should be circulated through the lantern ring *L*, separating the packing rows, Fig. 1. This oil enters at *D*, cools and lubricates the packing. As a general rule, unless suction pressure is quite high, lantern-ring oil pressure should be slightly higher than liquid pressure on the packing-box inboard side.

In some applications, suction pressure is high; otherwise, leakage of a small quantity of lantern-ring oil into the pump would contaminate the pumped liquid. When this condition exists gland-oil pressure may be reduced to below stuffing-box pressure. Then a small amount of pumped liquid leaks into the gland-oil stream.

Flushing Oil. Of all liquids handled by centrifugal pumps, the most difficult are some slurries, that is, liquids carrying abrasive materials in suspension. A typical example is a mixture of oil and catalyst used in fluid-catalytic cracking processes. Fig. 2 shows one type of a so-called slurry pump. Abrasive material must be prevented from entering the annular spaces between the casing and impeller wearing rings. If it enters, fine solids of the slurry erode the wearing rings or cause their surfaces to bind or gall. Also, abrasive material cannot be allowed to come in contact with packing. If it does, the solid particles tear and rip the packing, and make it useless.

These difficulties can be reduced by flushing with clean oil to prevent slurry getting between rings or into packing. Fig. 2 shows how this is done. Connections *A* and *B* lead to an annular space around each wearing ring. Fig. 3 is an enlarged cross section through the wearing ring on the back of the impeller. Flushing oil flows into the annular space around the rings and out through the space between them.

Oil flowing toward the impeller tends to keep out slurry. Behind the impeller, a small amount of oil also flows from between the wearing rings into chamber *S*, Fig. 2. This chamber connects by holes *H* to the impeller's suction side so there is a continuous oil flow from the back wearing rings to the impeller's eye. A similar flushing operation takes place in the front wearing rings.

The holes through the impeller also keep pressure on the packing down almost to suction value. In addition, a flushing-oil connection *C*, Fig. 2, is made into the throat ring. This connection leads to an annular chamber, Fig. 4, that surrounds the shaft. Oil flows into this chamber and out between the throat ring and shaft sleeve to *S*, to keep abrasive material out of this space and away from the packing.

Packing is further protected and lubricated by oil connection *E* to lantern ring *L*, between the packing rings. If temperature of the pumped liquid is high, the stuffing box may be cooled by water flowing through chamber *D*. The bearing may also be cooled by water flowing through the jackets around them.

On the pump, Fig. 2, the impeller, Fig. 5, has external or pumpout vanes *V* on its shrouds to reduce pressure on the impeller and casing wearing rings. These vanes also prevent solids accumulating between impeller and casing walls. With all these trouble preventives, there is not much chance of abrasive material going where it can do harm.

CURBS MOTOR TROUBLE

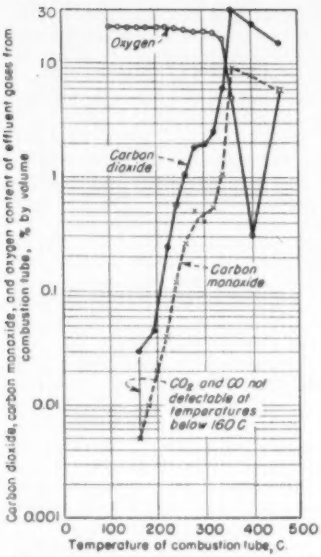
A LARGE CENTRIFUGAL pump was driven by a 1750-rpm slipring motor through a solid coupling. At about 4-month intervals the motor gave trouble by arcing at the brushes and sliprings. Insulation failed on brush holders and rings.

Grouting the motor and pump bedplate to their foundation did not correct the trouble. Checking pump and motor alignment did not help. We then decided that the motor and pump did not have enough end play for their rotors to center properly.

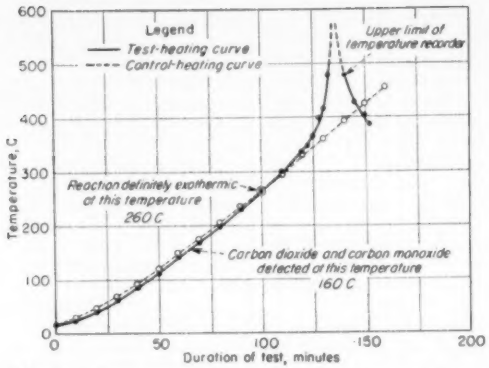
We took off the coupling and found only about $\frac{1}{8}$-in. play between the ends of the motor and pump shafts. A flexible coupling was suggested as a cure for our motor trouble.

To install this coupling, we cut $\frac{1}{2}$ in. from the motor and pump shafts and fitted the coupling halves. This was over a year ago. Since that time, motor and pump have run trouble free.

R O SPENCER *Philadelphia, Pa.*


Oxygen
Carbon dioxide
Carbon monoxide
CO_2 and CO not detectable at temperatures below 160 C
Carbon dioxide, carbon monoxide, and oxygen content of effluent gases from combustion tube, % by volume
Temperature of combustion tube, C

1 Evolution of CO_2 and CO and consumption of O_2 by hot carbon in air


Legend
Test-heating curve
Control-heating curve
Upper limit of temperature recorder
Reaction definitely exothermic at this temperature 260 C
Carbon dioxide and carbon monoxide detected at this temperature 160 C
Temperature, C
Duration of test, minutes

2 When air-compressor carbon is heated in a stream of air a temperature rise at 260 C indicates exothermic reaction

Why Do Compressed-

Many opinions and theories have been advanced on the cause of explosions in compressed-air systems. Here is a report* that ties a theory down with facts and figures to show how explosions can be compared to the spontaneous heating of coal

► Bureau of Mines experiments, conducted to learn why compressed air systems explode, indicate that a *carbon-oxygen complex* (C_xO_y) is formed on carbon deposits in compressors and piping. Theory of the existence of such a complex, the formation of which is *exothermic* (giving off heat), has long been accepted as the explanation of the spontaneous heating of coal. It is also recognized as playing a part in other reactions involving carbon and oxygen.

Demonstration of the existence of the carbon-oxygen complex in compressed-air systems does not indicate an immediate remedy for conditions that cause explosions or the formation of carbon monoxide in such systems. But the data are a basis for research.

Experiments were conducted with three samples of carbon deposits, *A*, *B* and *C*, from compressed-air systems.

Carbon A was obtained from the discharge pipe of a 2-cylinder single-stage compressor supplying air at 40 psi. The deposit, hard, black and oily, had to be chiseled loose. Composition was:

Constituent	*Ultimate analysis, as received, % by weight*
Moisture	5.9
Hydrogen	2.7
Carbon	54.2
Nitrogen	0.1
Oxygen	34.1
Sulfur	0.5
Ash	8.4

Of particular interest is the oxygen content of the material as related to the results of subsequent experiments. These showed that oxygen-containing gases, such as carbon dioxide and carbon monoxide, are liberated from the material upon heating.

Carbon B was taken from the discharge valve of the low-pressure cylinder of a large 2-stage compressor delivering air at 102 psi (second-stage discharge pressure). Sample was soft, extremely oily, and could not be sized or otherwise homogenized. Composition was:

Constituent	*Ultimate analysis, as received, % by weight*
Hydrogen	5.4
Carbon	49.1
Nitrogen	0.0
Oxygen	15.3
Sulfur	0.5
Ash	29.7

Further analysis of the ash indicated that it consisted of 1.4% silica, 21.4% iron oxide (Fe_2O_3), and 6.9% undetermined.

Carbon C came from the intake and discharge valves of the high-pressure cylinder of the same compressor from which carbon *B* was obtained. The sample was soft and less oily than *B*, but could not be sized exactly and was used in the experiments after rough screening and mixing to produce as uniform a sample as possible. Composition was:

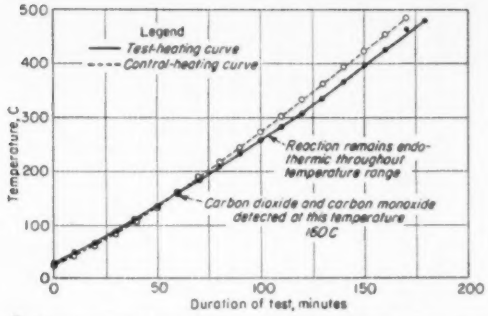
Constituent	*Ultimate analysis, as received, % by weight*
Hydrogen	5.1
Carbon	53.1
Nitrogen	0.0
Oxygen	20.0
Sulfur	0.8
Ash	21.0

Further analysis of the ash indicated that it consisted of 1.5% silica, 15.9% iron oxide (Fe_2O_3), and 3.6% undetermined.

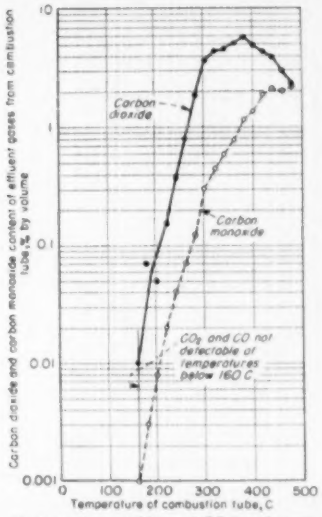
Samples *B* and *C* contained particles of metallic iron as well as considerable percentages of oxygen, as did carbon *A*.

Preliminary Work. First experiments were conducted to determine the be-

TESTING CARBON IN NITROGEN SHOWS CARBON-OXYGEN COMPLEX MAY BE THE CULPRIT



3 Heating carbon sample in a stream of nitrogen shows that reaction remains endothermic throughout temperature range



4 Evolution of CO_2 and CO by air-compressor carbon heated in nitrogen

Air Systems Explode?

By

H W BUSCH, *Assistant Chemist, Health Branch*

L B BERGER, *Senior Chemist, Health Branch*

H H SCHRENK, *Chief, Health Branch*

Central Experiment Station, United States Bureau of Mines

havior of the carbon when heated in a stream of air or nitrogen. A sample of the carbon (2.3 grams sized to 60 mesh, when possible) was placed in the lower end of a steel combustion tube surrounded by an electrically heated furnace. Furnace and combustion tube were heated at a rate increasing essentially in a linear manner with time.

Air or nitrogen was passed through the sample at 100 ml per minute, as indicated by a flowmeter. A bubbler, containing barium hydroxide solution, removed the normal carbon dioxide from entering air and also saturated the entering atmosphere with moisture. All experiments were conducted at atmospheric pressure.

The carbon was heated gradually and, at each increment of 20 C above 100 C, a sample of the effluent gases was collected for analysis. A water-seal prevented accidental back flow of air into the system.

*Abstract of Bureau of Mines Report of Investigations 4465, "The Carbon-Oxygen Complex as a Possible Initiator of Explosions and Formation of Carbon Monoxide in Compressed-Air Systems."

Experiment With Air. As shown in Table I, carbon dioxide and carbon monoxide were detected in the effluent gas when the carbon temperature reached 160 C, increasing in concentration as temperature increased. At slightly above 160 C, a definite decrease took place in the oxygen content of the effluent, indicating reaction of oxygen with the carbon. As air was passing over the carbon at a constant rate, the percentage composition values in Table I p 103, are a measure of reaction rate.

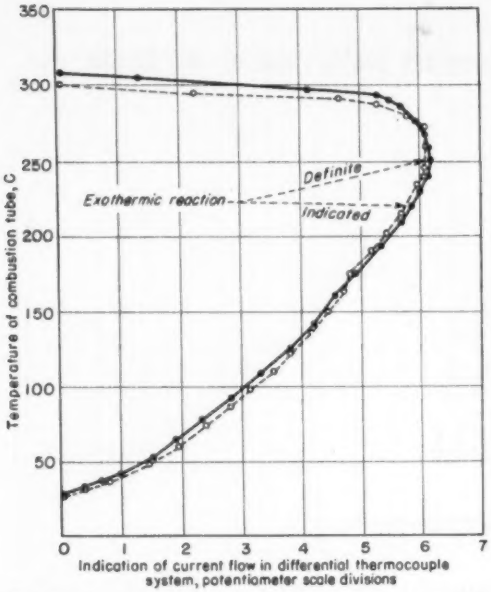
Rates of evolution of carbon dioxide and carbon monoxide, Fig. 1, bear essentially the same relationship to each other throughout the range of temperatures employed, a fact observed by other investigators. Jones and Townend state that the complex (with coal) is not destroyed completely until a temperature of 350 C is reached. Fig. 1 shows that concentration (or production rate) of carbon dioxide and carbon monoxide (decomposition products of the complex) reached a maximum at a temperature close to 350 C and then decreased at the higher temperatures.

Probably this apparently-reduced evolution rate of the decomposition products, at temperatures above 350 C, is not a real effect but merely a result of the lag effects inherent in a system not at equilibrium. That is, if the temperature had been held at 350 C, it seems probable the complex would have been destroyed completely, as found by Jones and Townend.

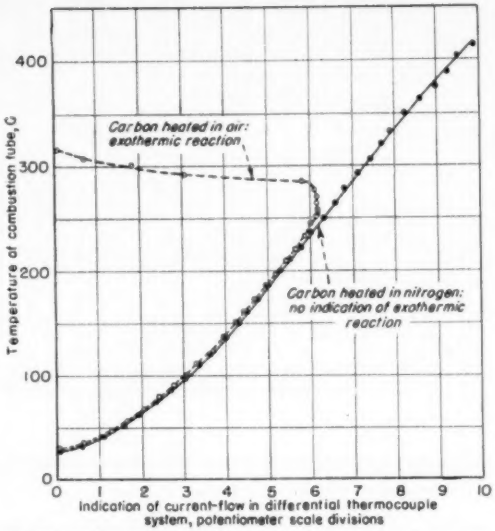
Oxygen consumption by the carbon (as shown in Fig. 1, coincident with the evolution of carbon dioxide and carbon monoxide) is evidence that formation of the complex by oxidation reactions and decomposition of the complex into its ultimate products took place simultaneously at different points on the carbon surface. Coincidence of these reactions with carbon in air is further illustrated by the results of a subsequent experiment in which the carbon was heated in a nitrogen stream.

Exothermic Reaction. Temperature effects produced by heating the carbon in air are shown in Fig. 2, where the test-heating curve (solid line) is compared with a control-heating curve (dotted line) obtained by heating the combustion tube in the same manner and at the same rate, with no carbon in the apparatus. The curves show that exothermic reactions predominated in the net thermal effect at temperatures above 260 C, at which point test and control curves cross.

This exothermic effect may have been



5 Heating curves change some at 220 C; exothermic reaction begins at 250 C and proceeds rapidly as shown by reversal


Temperature of combustion tube, C
400
300
200
100
0
Carbon heated in air: exothermic reaction
Carbon heated in nitrogen: no indication of exothermic reaction
0 1 2 3 4 5 6 7 8 9 10
Indication of current-flow in differential thermocouple system, potentiometer scale divisions

6 Comparing results of heating carbon in air and nitrogen shows exothermic reaction is caused by carbon oxidation

present at temperatures somewhat below 260 C, but was not definitely detectable because of lack of sensitivity in the temperature-measuring system.

Similarly, it appeared probable that carbon dioxide and carbon monoxide were produced by decomposition of the complex at temperatures somewhat below 160 C. But they were not detectable because of dilution in a continuous-flow system.

Experiment With Nitrogen. Table II shows that, when a sample of the carbon was heated in a stream of nitrogen, carbon dioxide and carbon monoxide were detected in the effluent gases from the combustion tube at 160 F—the same temperature at which the incidence of these gases was observed in the experiment with air. This indicates that decomposition of the complex is a result of temperature, and not related to the presence of oxygen in the ambient atmosphere.

Evolution of carbon dioxide and carbon monoxide by the carbon heated in nitrogen, Fig. 4, indicates, as did the experiment with air, that the rates of evolution of carbon dioxide and carbon monoxide bear essentially a constant ratio to each other except at the highest temperatures, which represent the final stages of decomposition of the complex. At these temperatures, lack of equilibrium in the system may have produced some effect.

Comparison of Fig. 1 and 4 shows that the evolution rates of carbon dioxide up to about 300 C are essentially the same whether the carbon is heated in air or nitrogen. This indicates decomposition of the complex is a reaction of the same type in both instances. Total quantity of complex decomposed was greater when the carbon was heated in air, which may be attributed to simultaneous formation and decomposition of the complex when heated in an oxidizing atmosphere.

The carbon heated in air lost 52.6% in weight, whereas that heated in nitrogen lost only 36.2%. This result indicates that the only reaction taking place when the material was heated in an inert atmosphere was decomposition of the complex existing on the carbon as a result of its previous contact with air in the compressor system. *The greater weight-loss on heating in air is attributed to the formation and decomposition of additional complex in the oxidizing atmosphere.*

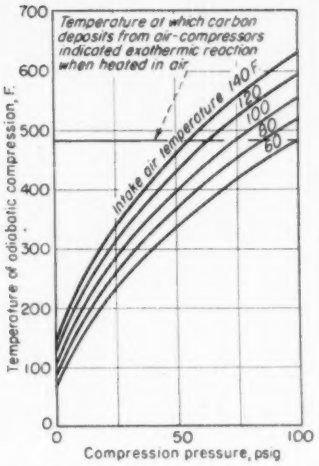
Temperature effects observed when the carbon was heated in nitrogen, Fig. 3, indicate, by the relative positions of the test and control curves, that heat was absorbed appreciably at temperatures above 160 C. This information demonstrates the *endothermic* (absorbing heat) nature of the decomposition of the carbon-oxygen complex.

Experimental data thus far presented agree quite well with the reactions of the carbon-oxygen complex based on the findings of the other investigators.

As the experiment of heating carbon in air shows, oxygen was consumed by the carbon, and the reaction definitely was *exothermic* (as shown by measurement of sensible heat). The experiment of heating carbon in nitrogen confirmed that decomposition of the complex is *endothermic*.

Evolution of Oxygen. In the experiment of heating carbon in nitrogen, Table II, oxygen content of the effluent gases from the combustion tube remained essentially constant at a low value. (The cylinder nitrogen used in this experiment contained 0.11% oxygen as an impurity. Minor variations in oxygen content, Table II, are not considered significant, as most of them are within the range of possible analytical error.)

Rhead and Wheeler observed that when carbon, already containing the carbon-oxygen complex, is heated in a stream of air, oxygen, present in the effluent gases as carbon dioxide, carbon monoxide and free oxygen, exceeds, on a percentage basis, the oxygen content (20.93%) of the entering air. This condition would not exist if the reactions involved were merely the combustion of carbon in air, as in that case the moles of oxygen entering the system should equal the moles of oxygen (free or combined) leaving it. Rhead and Wheeler attributed the effect they observed to rapid decomposition of the



7 Compression temperatures compared to exothermic-reaction starting point

carbon-oxygen complex that was present on the carbon as a result of previous contact with air.

The same effect was noted in the experiments herein described, in which air-compressor carbon was heated in a stream of air: Percentage of molecular oxygen, accounted for in the effluent gases [$CO_2 + O_2 + (CO \div 2)$] from the test apparatus, definitely exceeded the oxygen content of the entering air at temperatures above 260 C.

This temperature agrees rather closely with the temperature (250 C) at which coal heated in oxygen starts to lose weight, according to Porter and Ralston. These results are further evidence that the sample of air-compressor carbon contained the carbon-oxygen complex as a result of contact with air in the compressor system.

Modified Apparatus. Preliminary experiments thus far described demonstrated conclusively that air-compressor carbon contains a carbon-oxygen complex possessing many of the characteristics found in other types of carbon and carbonaceous materials. Before going farther with the experiments, the test-unit combustion tube was modified using differential thermocouples to detect the incidence of exothermic reaction. A continuous stream of air was passed through the tube (100 ml per min), and the tube heated at a rate linear with time.

(*Continued on page 168*)

TABLE I—COMPOSITION OF EFFLUENT GASES FROM AIR-COMPRESSOR CARBON-DEPOSIT "A" HEATED IN STREAM OF CARBON-DIOXIDE-FREE AIR

Sample No.	Temperature interval, C	Carbon dioxide	Oxygen	Carbon monoxide	Methane	Nitrogen
1	100-108	.00	20.92	.00	.00	79.08
2	120-127	.00	20.92	.00	.00	79.08
3	140-147	.00	20.93	.00	.00	79.07
4	160-167	.03	20.93	.005	.00	79.04
5	180-187	.05	20.91	.01	.00	79.03
6	200-207	.04	20.87	.02	.00	79.07
7	220-227	.24	20.68	.04	.00	79.04
8	240-248	.57	20.31	.12	.00	78.95
9	260-268	1.04	19.75	.26	.00	78.95
10	280-290	1.87	18.99	.51	.00	78.63
11	300-306	1.92	19.17	.41	.00	78.50
12	320-325	2.54	18.83	.55	.00	78.08
13	340-350	5.98	16.40	1.09	.00	76.53
14	360-410[1]	29.20	4.80	9.20	.70	56.10
15	400-412	22.20	.30	8.10	.50	68.90
16	420-480[2]	15.75	5.88	5.88	.35	72.14

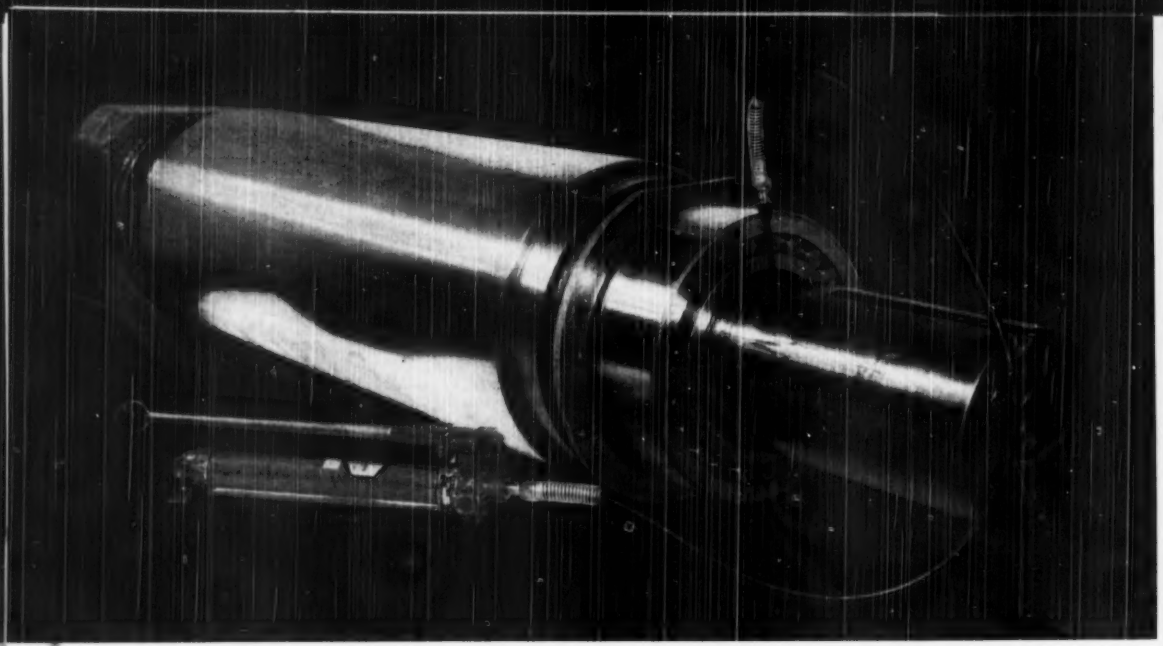
[1] Rate of temperature increase due to exothermic reaction beyond control range of test apparatus.
[2] Upper limit of temperature recorder.

TABLE II—COMPOSITION OF EFFLUENT GASES FROM AIR-COMPRESSOR CARBON-DEPOSIT "A" HEATED IN STREAM OF NITROGEN

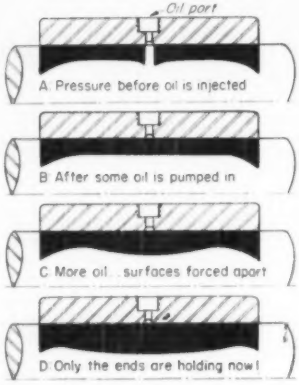
Sample No.	Temperature interval, C	Carbon dioxide	Oxygen	Carbon monoxide	Methane	Nitrogen
1	100-105	.00	.19	.00	.00	99.81
2	120-125	—	.11	.00	.00	99.85
3	140-144	.00	.16	.00	.00	99.83
4	160-168	.01	.17	.001	.00	99.82
5	180-185	.07	.07	.003	.00	99.86
6	200-206	.05	.15	.008	.02	99.76
7	220-225	.15	.10	.02	.02	99.71
8	240-245	.37	.02	.04	.02	99.55
9	260-265	.80	.11	.07	.06	98.96
10	280-288	1.86	.03	.12	.05	97.94
11	300-310	3.63	.25	.30	.08	95.74
12	320-324	4.37	.14	.44	.10	94.95
13	340-353	4.54	.19	.59	.11	94.57
14	360-370	5.14	.14	.78	.16	93.78
15	380-392	5.69	.10	1.17	.26	92.78
16	400-408	4.84	.15	1.37	.29	93.35
17	420-433	4.30	.50	1.90	.40	92.90
18	440-448	3.95	.13	2.12	.36	93.44
19	460-468	2.90	.50	2.00	.40	94.20
20	480	2.30	.40	2.20	.40	94.70

TABLE III—RESULTS OF HEATING AIR-COMPRESSOR CARBON IN AIR IN A CLOSED, RECIRCULATING SYSTEM FOR FOUR HOURS AT CONSTANT TEMPERATURE

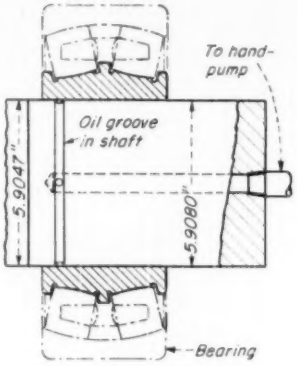
Experiment No.	Temperature of combustion tube, C	Composition of atmosphere in closed system after 4 hours heating, percent by volume				
		CO_2	O_2	CO	CH_4	N_2
1	60	.06	20.90	.000	.00	79.04
2	98	.05	20.89	.002	.00	79.06
3	125	.06	20.90	.005	.00	79.03
4	130	.06	20.90	.007	.00	79.03
5	150	.18	20.80	.018	.00	79.00
6	180	.50	19.84	.093	.00	79.57
7	230	4.55	12.81	.96	.20	81.68



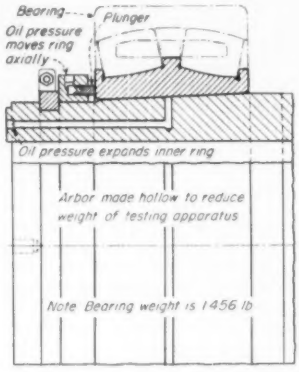
1 Anti-friction bearings on this calendar roll are mounted and removed by the oil-injection technique. Method calls for a light, high-pressure hand pump to force oil through a small hole leading up under the inside race of roller bearing


Oil port
A. Pressure before oil is injected
B. After some oil is pumped in
C. More oil ... surfaces forced apart
D. Only the ends are holding now!

2 Height of the solid black areas is a measure of bearing-surface pressure



3 Bearing will move to left when oil is pumped despite 0.0028-in. shrink


Bearing
Plunger
Oil pressure moves ring axially
Oil pressure expands inner ring
Arbor made hollow to reduce weight of testing apparatus
Note: Bearing weight is 1456 lb

4 Laboratory model has an oil-operated plunger rig to check the axial push

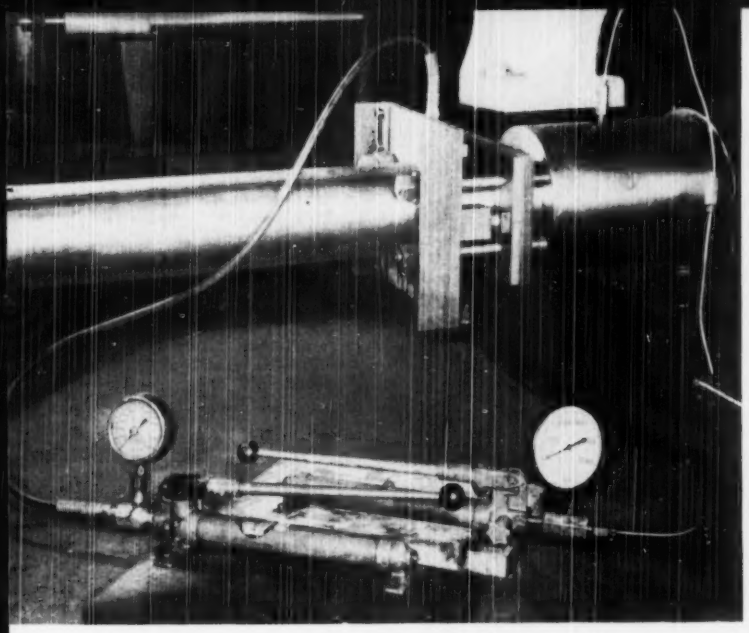
Oil Pressure From Hand Pump Makes

That goes for rigid couplings and gears as well. It's simply a matter of building up oil pressure under the bearing bore until inner race expands clear of shaft. Bearing will then slide off on oil film. The same technique holds for mounting

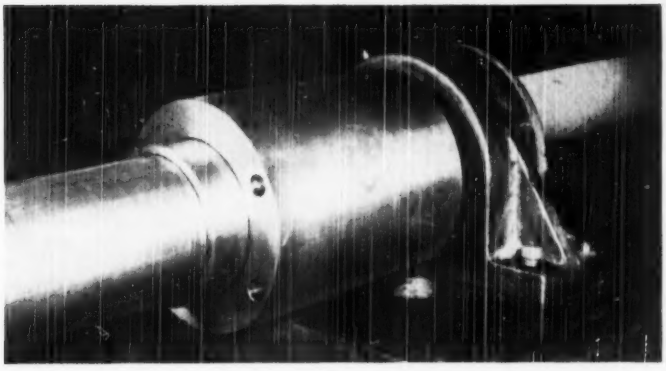
By **A STEWART MURRAY**, *Assistant Chief Engineer, SKF Industries Inc.*

► UP TO A FEW YEARS AGO, one problem connected with large antifriction bearings was the tough job of mounting and removing them. Often the creep of loose-fitting bearings, and resulting shaft scoring, came to be accepted. Alternative was an adequate interference fit and its associated problem when installing and removing.

Removing With Oil. For several years,



5 Hydraulic ram, *at left,* forces outer coupling piece up on inner sleeve, Fig. 7. At same time, hand-pump squeezes oil between outer and inner coupling sleeves



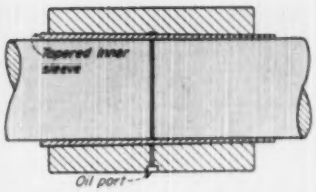
6 Note absence of keys and setscrews on this two-piece rigid coupling, Fig. 7. Tapped holes on the outer sleeve take bolts from the hydraulic mounting ram

Bearing Removal a Cinch

the oil-injection method has been used to mount and dismount antifriction bearings, rigid couplings and gears. Principle involved is simple enough: If oil is injected between contact surfaces of a pressure-joint, friction almost disappears. Oil pressures run between 5000 and 25,000 psi, depending on the specific pieces and their respective jobs.

When a ring is shrunk on a cylindrical shaft so an interference fit results, contact pressure between the two parts is not constant along the shaft. Fig. 2 brings this out nicely. Here black areas indicate schematically how pressure varies from one end of the ring to the other. Note edge loading; that's caused by the shaft being compressed by ring edge.

A hole drilled radially, connected to



7 Inner sleeve makes slide-fit on both shafts. Oil expands the outer sleeve

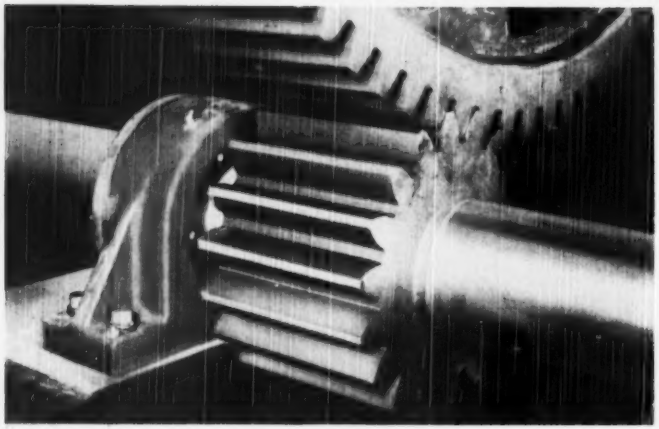
a groove in the ring bore, allows oil under pressure to work in between the contacting surfaces. Let's look at Fig. 2 more closely. In Sketch *A*, at top, we see pressure distribution along the entire length of contact before oil is introduced. In Sketch *B*, pressure distribution is shown after some oil has been pumped in. Here, oil has reached a pressure equal to contact pressure at the joint next to the oil groove.

As pressure increases by introducing more oil, the contacting surfaces are forced apart as in *C*. At this point oil starts flowing into the joint's more distant parts. In final stage *D*, a thin oil film separates the contact surfaces, except a narrow zone at each end of ring. Here, contact pressure is greater than at any other part of the joint. This is caused by the influence of the shaft material beyond the ring's ends. The phenomenon is called "end effect." Incidentally, this condition makes the oil-injection method effective. End zones act as oil locks, retaining oil until pressure rises enough to further expand the ring. In the final stage an oil film completely separates all parts thus preventing any real metallic contact. The ring then slides off.

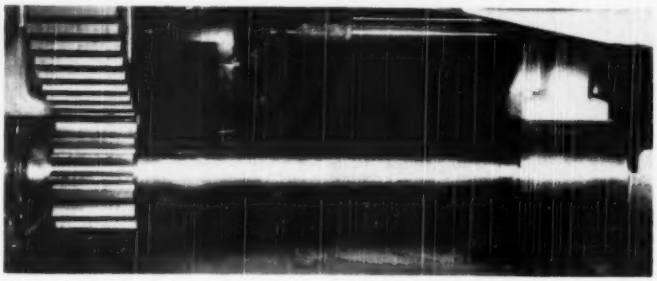
Laboratory experiments show that, by introducting oil between contact surfaces, friction is reduced to 1 to 2%, or less, of that normally existing. But when pressure is released, oil escapes through the oil port and the original friction is restored.

It is possible to calculate contact pressures that exist where bore of outer ring is smaller than outside diameter of inner shaft. Those so inclined may find the basic formula in Timoshenko's *Strength of Materials*, 2nd edition, Part II, Chapter 5.

How It Works. Take the bearing in Fig. 3. When oil pressure is built up, dead weight of the bearing itself displaces the bearing a distance greater than its width. This move uncovers the oil port at least an inch. Note in this sketch that the oil port is much closer to one side of the straight bore bearing. This is an important detail. Off-center location of the oil port should be in the same direction as the motion when strip-



8 Pinion fitted with oil grooves and pressure fitting; see Fig. 10. Easily mounted and removed with small hand pump. Lineshaft is 7¼-in. diameter

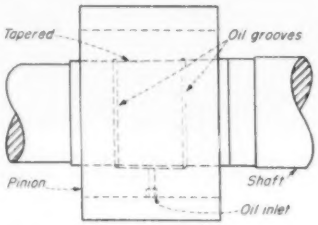


9 Lineshaft, driven by 250-hp motor, has pinion and rigid coupling mounted by oil-pressure technique. Are gear pullers and strong backs on way out?

ping a bearing from its seat. This stands to reason since, once the movement uncovers the oil outlet, bearing motion stops. Result is the bearing with off-center oil port moves a greater distance before oil port is uncovered.

Bearing removal is simpler with a tapered than with a straight bore. With the latter, the bearing does not come completely off its seat. It hangs on till pressure from another source completes the removal. In Fig. 3, force for this final move varies from 5000-12,000 lb. But when the bearing is removed by the old brute-force method, initial resistance varies between 50,000 and 60,000 lb. On top of that it is a great help to pull only ½ in. rather than 4 in., and with 16% of the effort. While the hydraulic method is of great help in dismounting bearings with cylindrical bores it is most effective with parts having mating tapers.

Bearing in Fig. 4, a laboratory model, demonstrates that the oil-injection method works equally well with large and small bearings. Tapered-bore bearing



10 Double grooves cut in pinion bore tend to equalize the oil pressure

is mounted directly on a seat with a 1:12 tapered diameter. Let's consider a few facts on this particular bearing. When oil pressure on the plunger alone is 2800 psi, the 44-sq-in. working area develops an axial push of 123,000 lb. This force expands the ring only 0.0024 in. When, in addition to plunger pressure, oil is introduced into the bore at 3300 psi, outside diameter of inner ring further expands another 0.010 in. before it's free. These figures indicate the bearing is mounted with the equivalent of 0.0124-in. interference fit between bore and seat.

Remember, there is an axial component of force from the hydraulic pressure present between a tapered bore and its seat. This force equals area of the seat's axial projection times average pressure over the oil-film area. In Fig. 4, axial force equals 99,000 lb if we use estimated average pressure of 3250 psi.

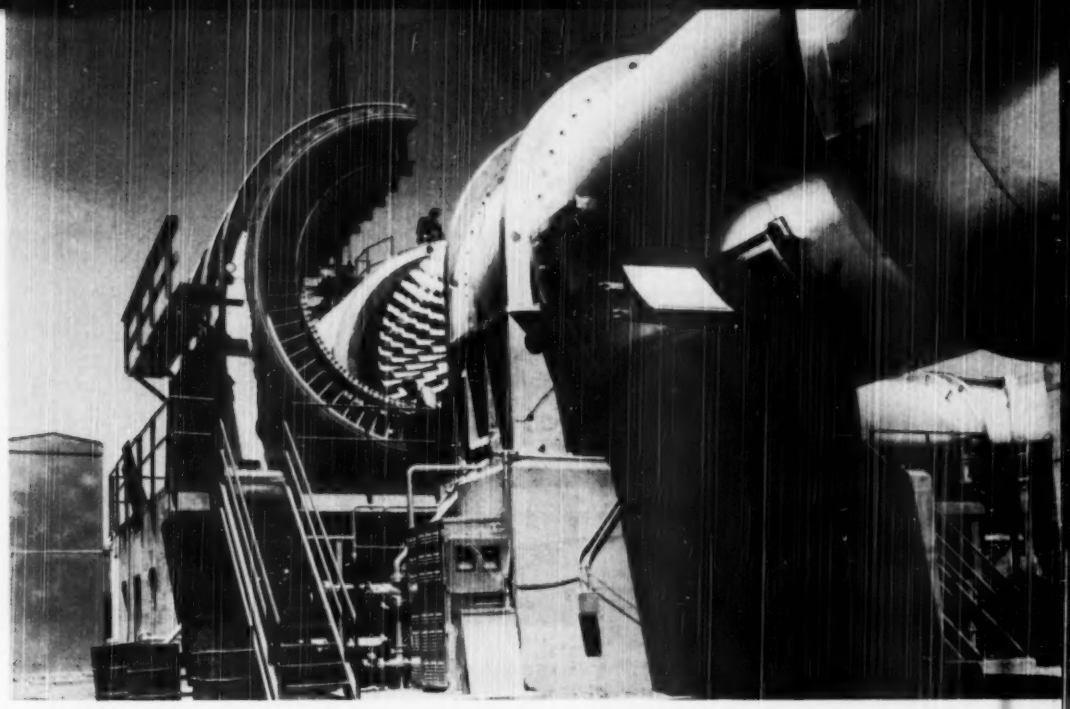
Outside pressure is applied to the bore only when mounting a tapered bore piece. In practice, when the tapered piece is removed it pops off with some force. Hence it's good practice to install a safety stop to prevent injury to people or possible equipment damage from over-travel, particularly when the axis is horizontal. Total weight of the assembly in Fig. 4 is 1500 lb. When that bearing was popped off, the whole unit jumped about ½ in.

Applications. Our aim in developing the oil-injection technique was to make roller bearings more enticing for supporting marine shafting. One feature of sleeve bearings was they allowed use of couplings forged to end of each section of shafting. A forged coupling couldn't be used with antifriction bearings since it prohibited mounting and removal of bearing. Keys, keyways and drive fits introduced difficulties in the conventional removable couplings. Hence development of the rigid coupling, Fig. 7. Note absence of keys.

To unite two perfectly cylindrical shaft ends, this coupling depends on pressure only. Same basic oil-injection technique is used to mount and dismount this coupling. An outside micrometer is the only instrument needed to determine when outer sleeve has expanded enough to "float" on inner.

At present, the oil-injection trick includes gears in its sphere of influence. Look at Fig. 8 and note the pinion meshing with its gear. Gear is positioned with a large gib-type key, while pinion is unkeyed and mounted with the hydraulic method. Fig. 10 shows clearly the gear construction and lack of keys. Lineshaft between coupling and pinion, Fig. 9, is 7¼-in. diameter.

In developing a rigid coupling that was adequate, removable, practical, we found the oil-injection method greatly simplified the job of making and breaking heavy interference fit. Applying this technique to mounting and dismounting roller bearings made interesting laboratory study some years back. Now many companies accept it as routine practice for large roller and ball bearings—not to mention rigid couplings and gears.



BIG WIND for testing aircraft models in supersonic wind tunnel comes from 416 rotor blades in giant axial compressor

Big Wind Takes Big Push

► EXPLORING THE FRONTIERS of supersonic flight, even with models in a 6x6-ft wind tunnel, takes power and plenty of it. At NACA's new Ames Aeronautical Laboratory, Moffett Field, Calif., an 8-stage axial compressor pushes air past test models at flows up to 1,700,000 cfm and at speeds from 840 to 1500 mph.

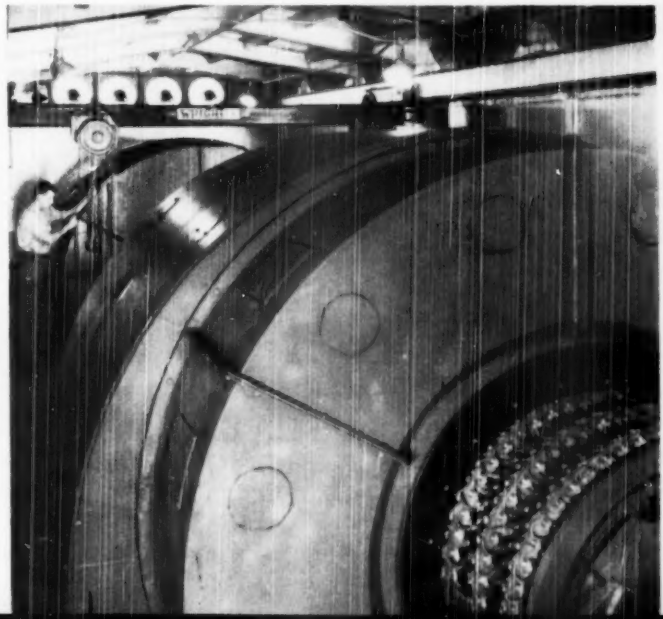
It takes 50,000 hp of main drive motors to do the job, backed by liquid rheostats for speed control from 775 to 900 rpm, transformers and switchgear. Other electrical equipment includes variable-frequency mg sets and a host of motors for auxiliaries.

A big wind like this one generates plenty of heat—enough to require more than ten miles of bronze tubing for 117,000 sq ft of cooling coils inside the tunnel. About 10,000 gpm of water flow through these coils, supplied by a 6-section cooling tower and a king-size pump. A smaller pump provides cooling water for electrolyte, oil and air heat exchangers.

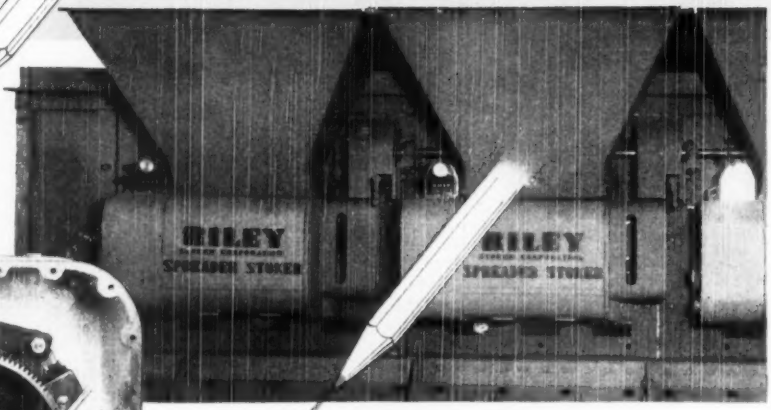
Photos: Westinghouse Electric Corp

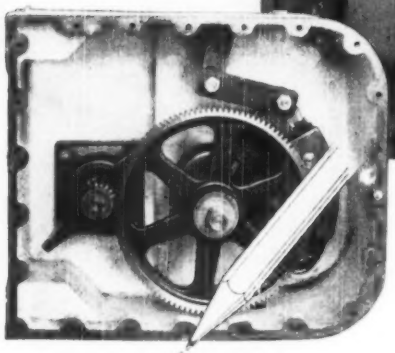
MORE PIX ON PAGE 110

BIG PUSH comes from tandem 25,000-hp motors, direct-connected by an extension shaft to axial compressor above. Rotating mass of combination is about 450,000 lb



Check These 4 Items





1 FEEDER DRIVE

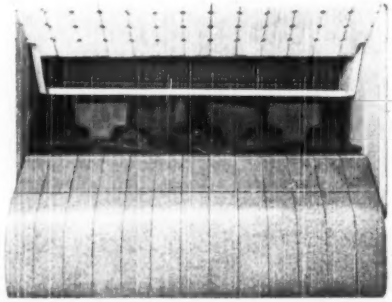
Check for — **simplicity**
accessibility
ease of lubrication
maintenance

The Riley Spreader Stoker feeder drive employs an adaptation of the Stephenson link mechanism giving an extremely simple drive which provides complete speed control from zero to maximum coal feeding capacity. The mechanism is completely enclosed and is splash lubricated practically eliminating maintenance.

2 DISTRIBUTOR

Check **whether overthrowing or underthrowing; means for adjusting lateral distribution; accessibility**

Riley employs the overthrowing distributor which provides the most uniform longitudinal distribution and prevents damage and outage caused by wedging of foreign materials between distributor and housing. The angle of the distributor blades is adjustable in order to vary lateral distribution. Ready access is provided to distributor from front of stoker.



TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston · New York · Philadelphia · Washington · Buffalo · Pittsburgh · Cleveland · Detroit · Chicago
Cincinnati · Atlanta · New Orleans · Memphis · St. Louis · Kansas City · St. Paul · Tulsa · Houston
Denver · Salt Lake City · Los Angeles · Portland · Seattle

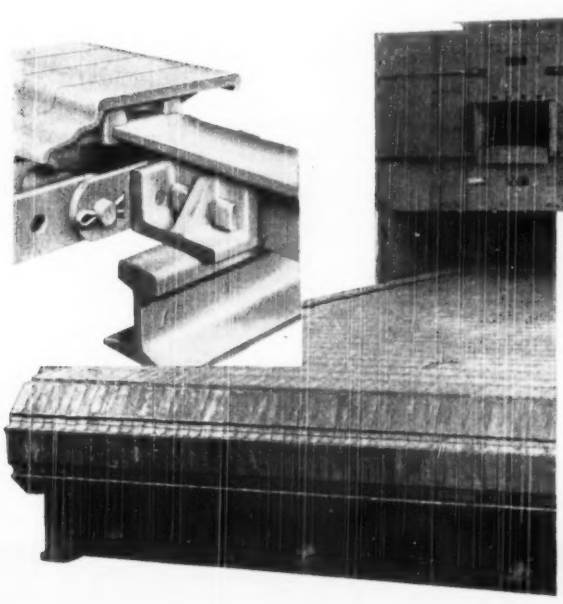
BOILERS · PULVERIZERS · BURNERS · STOKERS · SUPERHEATERS · FLUE GAS SCRUBBERS

when Purchasing Spreader Stokers

3 GRATE DRIVE

Check for — **range of control**
lubrication
power required to drive
simplicity

Riley uses a hydraulically driven ratchet drive completely enclosed. This simple rugged drive automatically lubricated has practically no maintenance, is not susceptible to damage in case of grate obstruction and has low power consumption.



4 GRATE SURFACE

Check for —
method of support
size of individual grates
air distribution

The Riley grate surface consists of small grates only 2 inches wide with 6-inch pitch, mounted on carrier bars which are bolted to skid shoes fastened to rugged steel roller conveyor chains. The skid shoes slide on a rail. This construction eliminates all strains from the grates themselves. By use of large numbers of small grates uniform air distribution and low maintenance is obtained.

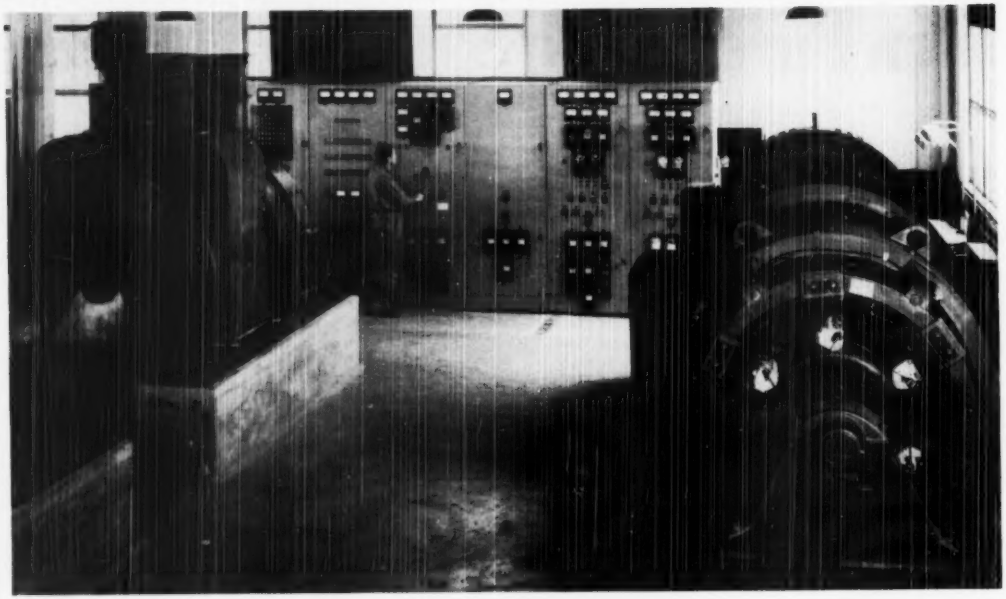
A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

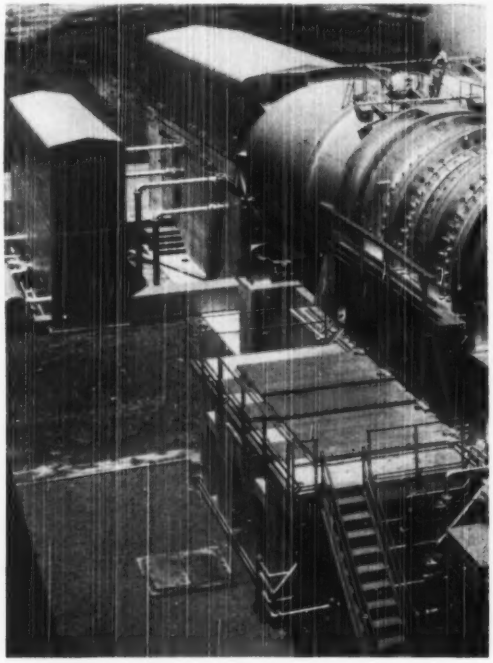
. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS · WATER-COOLED FURNACES · STEEL-CLAD INSULATED SETTINGS · AIR HEATERS

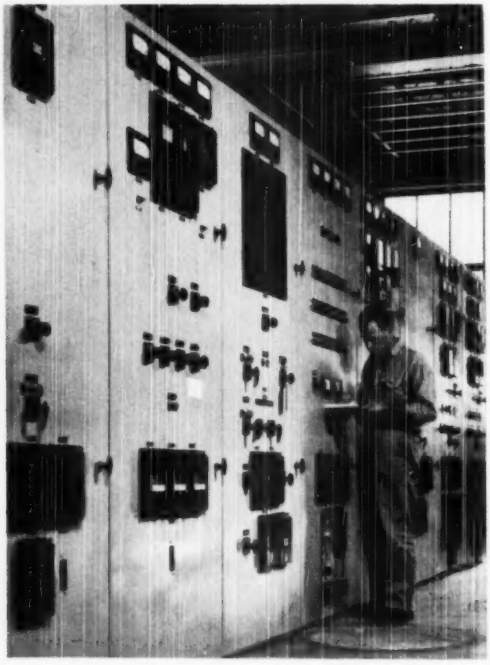
Big Wind Takes Big Push *(Continued from page 107)*



FLEXIBLE POWER is needed for the varied research jobs at Ames Aeronautical Laboratory. Here's part of the electrical setup to produce it. Variable-frequency mg sets *(left)* provide frequencies up to 800 cycles. Constant-speed mg sets *(right)* play their part in making power to drive the variable-frequency units at speeds desired for testing purposes



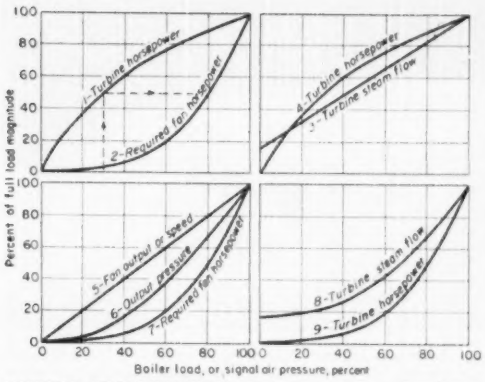
LIQUID RHEOSTATS in housing at left regulate speed of two main-drive motors in compartment just beyond corner of the wind tunnel to produce air speeds from 840 to 1500 mph



HIGH-VOLTAGE SWITCHGEAR includes oil circuit breakers for 25,000-hp motors, protective relays, etc. Nearby outdoor substation steps down incoming 110,000-v current to 6600 v

LETTERS FROM A TURBINE SPECIALIST—10

By E W BURSTADT, *Turbine Divisions, General Electric Co*



VARYING CHARACTERISTICS of boiler air flow, fan horsepower, turbine steam flow, and output must be matched properly

Control Needs Fix Governor Selection

Turbine Specialist
District Office
Dear Mr Specialist

In your recent quotation covering a mechanical-drive turbine for our boiler induced-draft fan, I notice you offer an "oil-relayed governor." This turbine is smaller than some of those we use for pump drives. These all have regular mechanical-drive-type governors.

Why can't you give us a turbine with the less expensive "standard governor" for the fan drive? Steam conditions for all these drives are the same. I certainly would prefer to get by with the least expensive turbine.

Very truly yours,
ENGINEER

Dear Mr Engineer

A mechanical-drive turbine with a standard governor can be used to drive induced- or forced-draft fans. Method of controlling the fan, not the fan itself, may require using an oil-relayed governor. This problem is in the province of fan and control manufacturers. Their solution affects the turbine arrangement. For constant-speed drive, with damper or inlet-vane control on the fan use the standard governor.

For a variable-speed drive regulated by the combustion-control system the problem becomes more involved. A standard unit may still be used, but must be controlled by a valve in the steam line ahead of the turbine. This valve has its characteristics matched to that of the boiler system. Signals from the combustion control position the valve. Then the turbine governor functions only as a speed-limiting device when the control calls for an excessive speed.

As indicated in the quotation, a more elaborate turbine governing system may be used. This will be directly regulated by the combustion control system. What difference does the type of turbine governor make?

External control is usually applied to standard mechanical-drive turbines by linking a diaphragm-type air motor directly to the governing valve. Air-motor travel is directly proportional to the air signal from the regulator. Hence valve position also varies as a straight-line function of air signal.

This works fine when a regulator connects to a pump to maintain constant output or differential pressure. With a fan drive under combustion control, however, the situation arises that is shown by curves 1 and 2. Curve 1 shows the turbine horsepower developed in response to signal air pressure. Curve 2 gives the fan horsepower input demand to produce the air flow required by the same signal. While the system can be made to supply the correct amount of air at two boiler loads, it will be out of balance everywhere else. For example, in response to an air signal for 30% load the turbine develops an output that makes the fan produce air flow for 80% load.

In the usual combination of boiler, fan and control, the air signal is proportional to boiler load. Air-motor travel is proportional to air signal and with the turbine valve linked directly to the air motor, valve travel will be proportional to air signal and boiler load. Over the normal range of operation, valve lift is proportional to flow, so steam flow to turbine varies with boiler load, as shown by curve 3. This steam flow produces the turbine horsepower output characteristic shown by curves 1 and 4. Exact relation varies with steam conditions, rated speed, turbine size, but this characteristic shape will hold.

For the fan, amount of air needed varies directly with boiler load as shown by curve 5. To produce this air flow, fan speed also varies directly with needs, hence it is also proportional to boiler load. Since the boiler behaves essentially as a fixed orifice, the pressure to move this air varies as the square of the flow, curve 6. With this pressure and flow characteristic the horsepower needed varies as the cube of the fan speed. This gives us the fan-horsepower curves 7 and 2.

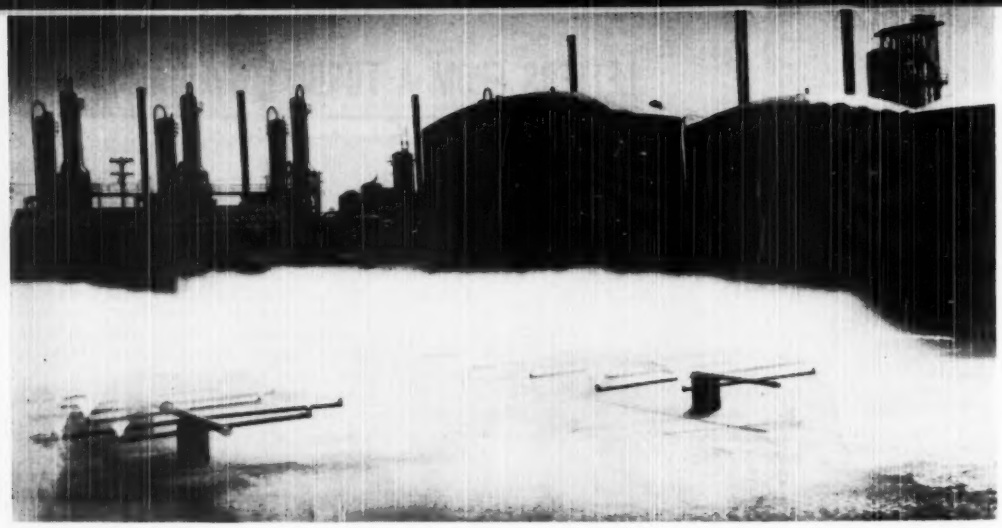
To reconcile the divergent curves 1 and 2 we can put a separate control valve in the steam line ahead of the turbine, as we mentioned above. This valve will be proportioned to give a steam-flow valve-travel characteristic shown by curve 8. Since valve travel is proportional to signal-air pressure, curve 8 will also be true when plotted against boiler load.

This steam flow will develop the turbine-horsepower output curve 9, which matches the fan horsepower curve 2 and 7. Such a valve might be incorporated in the turbine valve chest in place of the regular governing valve. This would be considerably more expensive, however, than a separate valve.

An oil relay or other governor that can be regulated in terms of speed in response to an air signal sidesteps these valve-flow travel-output problems. With such a governor, a given signal calls for the necessary fan speed to give the desired output, curve 5. The turbine-speed governor will position the control valve to supply the steam needed.

Unfortunately, the usual mechanical-drive turbine governor cannot be controlled in terms of speed in this manner over a wide enough range. To put the control directly on the turbine it must be applied to the valve with the complications we just discussed. Let's talk this over further the next time we meet.

Sincerely yours,
TURBINE SPECIALIST



SPRAY PONDS make far more effective use of a given area than do ordinary cooling ponds. This results from breaking up the water into small droplets, thus exposing more water surface per sq ft of ground and creating intimate contact

Evaporative Cooling—Potent Weapon

Worried about water shortages? Concerned because the cost of water for cooling purposes is too high? Evaporative cooling lets air do most of the work, cuts water use to a fraction. Here are practical pointers on modern methods and equipment

By **HOWARD E DEGLER**, *Technical Director, The Marley Co, Inc*

► NEWSPAPER HEADLINES of "water crises" in New York and elsewhere only serve to sharpen up what engineers have known for some time. Water use in industry — for power generation, for cooling, for processing—has grown by leaps and bounds. As reflected in terms of availability or cost, water needs play a large role in selection of sites for power and industrial plants and in the economics of refrigeration, air conditioning and industrial processes.

Evaporative cooling can help effectively in either case. Where water supplies are limited, it makes them go farther; where water is readily available but costly, as in some areas, it cuts cost. It does this by making air do most of the work. Evaporative cooling takes a number of forms. This article deals with cooling and spray ponds.

How It Works. Basic idea of evaporative cooling is simple. If we bring water into contact with atmospheric air, some water evaporates. It takes heat to do this—more than 1000 Btu per lb—and this heat comes from the rest of the water. This cooling by *latent heat* is many times greater per pound of water than is cooling by sensible heat. Thus, working in cooperation with the air, a pound of water can do a great deal more cooling. Or, a given cooling job can be handled with much less water.

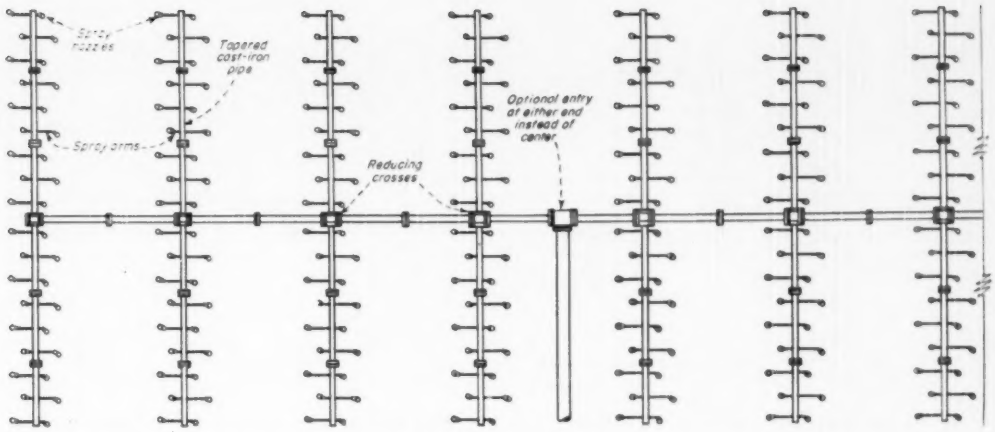
Rate of heat removal by atmospheric cooling water depends on: (1) area of water exposed to air (2) difference in temperature between water and wet-bulb temperature of the air (3) relative velocity of water and air at contact, and (4) time of contact. As we'll see, development of evaporative-cooling equipment has resulted from efforts to improve these factors.

Spray Ponds. For large water-cooling requirements, cooling ponds were once widely used. They were simple and usually cheap. Yet their limitations became evident as increased demands were placed on them. Need for more effective use of ground area led to application of spray ponds, in which area of water exposed to air and relative velocity are increased by breaking water up into small droplets.

A typical spray pond consists of a water-collecting basin above which are nozzles to spray water upward. Properly designed spray nozzles break water up into small drops but not into a mist. Since the objective is to cool the water, not to let it drift away on the breeze, individual drops must be heavy enough to fall back into the pond. Water surface exposed to air passing over the pond is the summation of all the drop surfaces.

A spray pond will do the same amount of cooling with about one-fiftieth the space of a cooling pond. This results from: (1) speed with which drops are propelled into the air and fall back to the pond (2) increased wind velocity above surrounding obstructions (3) increased volume of air because of greater vertical cross-section of air in contact with water, and (4) vastly increased area of contact between the water and the air.

Design Factors. Usual practice locates nozzles from 5 to 6 ft above water surface. This depends also on water depth and curb level. Nozzle pressure runs 5 to 6 psi, with nozzles spraying from 25 to 50 gpm each. For good results, nozzles should be spaced so average water delivered to the surface varies from 0.1 gpm per sq ft (small ponds) to 0.4 gpm per sq ft (large ponds). See table below for additional design data. Best practice is to place nozzles in a



PIPE AND NOZZLE LAYOUT for a 10,000-gpm spray pond. Note use of tapered pipe (12-ft lengths), staggered nozzle spacing and centrifugal nozzles. Reduced friction, more effective spray pattern, in given area, cut pumping requirements

For Water Conservation

long, relatively narrow area, broadside to prevailing winds.

Enclosures. Louver fences to prevent air carrying entrained water beyond pond edge on leeward side are required for all roof locations and for ground installations where space is restricted. Outer nozzles should be at least 20 ft from edge of basin. Such fences are usually built of horizontal overlapping louvers, supported between vertical posts. They run up to 12 ft high. Air passing through these louvers tends to be freed of larger water drops. Louvers also restrict air flow, particularly at higher wind velocities, thus reducing possibility of water being carried from the spray cloud. Height of an effective fence should be equal to height of spray cloud.

Algae formations may be a nuisance in spray ponds. Such growths are minimized by periodic addition to pond water of bromine, chlorine, copper sulfate, or other chemical compounds that have been found effective.

Selection Factors. Until ten years ago, first cost of spray ponds usually compared favorably with other water-cooling means. Advantages are: (1) no power requirement for fans, and (2) low maintenance and depreciation if proper materials are used (cast-iron pipe and fittings with bronze nozzles). Disadvantages are: (1) spray drift may make area adjacent to pond unusable, and (2) limited cooling performance. It is impractical to design spray ponds for severe cooling conditions—close approach to wet-bulb with a long cooling range.

Spray-Pond Performance may be approximated by assuming that range and approach are equal. Water-cooling efficiency may then be measured by:

$$\frac{\text{Hot-water temp} - \text{cold-water temp}}{\text{Hot-water temp} - \text{wet-bulb temp}}$$

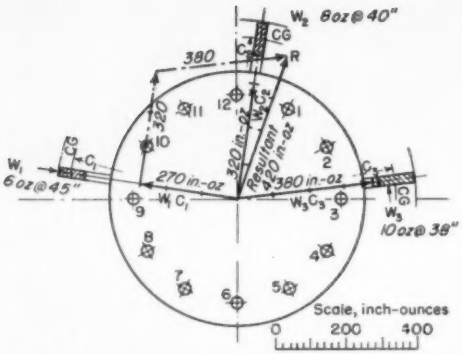
For a typical case this would be 100 F – 90 F, divided by 100 F – 75 F. This yields an efficiency of 40%.

Higher cooling efficiencies could be obtained by: (1) increasing water pressure (2) spacing nozzles farther apart (3) increasing nozzle elevation (4) using smaller capacity nozzles to decrease concentration of water per unit area (5) using smaller nozzles and higher pressure to maintain same concentration of water per unit area. Of course, lower wet-bulb temperatures help greatly.

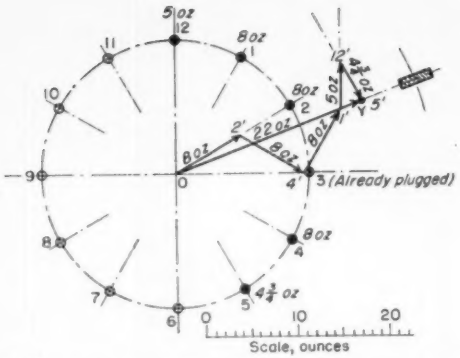
Limitations. Basic reason for relatively limited performance range of spray ponds is the fact that water is broken up into drops only once. Thus rate of cooling diminishes rapidly as drop-surface temperature approaches air wet-bulb temperature. Additional cooling may be had by spraying water a second time, but this means doubling space and pumping equipment and is seldom attempted. In contrast, the cooling tower allows the designer to secure wide performance range by altering physical dimensions or water concentration. The next article will show how this is done, with an explanation of all the detail involved.

SPRAY-POND DESIGN DATA — CONVENTIONAL UP-SPRAY SYSTEM

	Standard	Minimum	Maximum
Nozzle capacity, gpm each	35-50	25	50
Nozzles per 12-ft length of pipe	6	4	6
Height of nozzles above water level, ft	6	5	7
Nozzle pressure, psi	6	5	7
Size of nozzles and nozzle arms, in.	2	1.5	2
Distance between spray lateral piping, ft	25	13	38
Distance nozzles from pond side (unfenced), ft	25-35	20	50
Distance nozzles from pond side (fenced), ft	15-20	15	25
Height of louver fence, ft	12	12	12
Depth pond basin, ft	4-5	2	—
Friction loss allowed per 100 ft pipe, ft	1-3	—	—
Design wind velocity, mph	5	3	—



1 To find the balance weight needed to replace three missing blades, combine the vectors as shown to get the resultant *R*

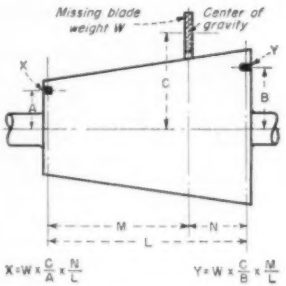


2 When balance weight must be distributed among several holes, weights in each hole are found by vector addition

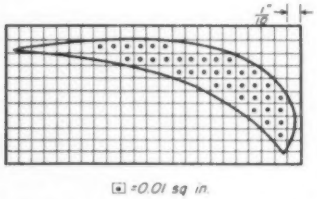
Don't Balance Rotor by Cutting Blade

Do vector calculations baffle you? Here an expert tells how to use them in rebalancing a turbine rotor that has lost a blade accidentally. Step-by-step explanation eliminates mystery, helps preserve good blading with balance plugs

By T C RATHBONE, *Chief Engineer, Machinery Division*
The Fidelity and Casualty Co of N. Y.



3 Missing blade weight can be compensated by adding weights at X and Y



4 Estimate blade's cross-sectional area by plotting its shape on graph paper

► SOMETIMES A STEAM TURBINE must be returned to service at once in spite of a damaged rotor blade. If one or more blades have broken or been cut off, the rotor will be seriously unbalanced. So before running the turbine the rotor has to be restored to balance to insure smooth operation.

Cutting off equal amounts of blading diametrically opposite the lost portion will do the job. Destroying good blading, however, is nonsensical when simply screwing in weights in the balance holes does the trick. Operators mutilate good blading because they do not know how to make the easy calculations necessary to find the balance weights. Here we'll show how that's done.

Although dynamic balancing is a specialized field, there's nothing mysterious about figuring balance weights to restore exact dynamic balance. You need nothing more than plain arithmetic. We'll talk about a formula to accommodate all cases and about a method to take care of several missing blades at various angular positions. The four figures on this page summarize all the operations.

Single Missing Blade. Rotor in Fig. 3 has a ring of balancing holes in each end. In one of the rows a portion of a blade has broken off above the root, the shaded part. Let's find the amount of balance weight at *X* and *Y* that will compensate for the missing blade weight *W*, both statically and dynamically.

First, find the weight of the missing portion. This is easy if the piece is available. If not, cutting off a like portion from an identical scrapped blade will do. As a last resort, the weight can be estimated by using 4.5 oz per cu in. for steel. The blade-section area can be found fairly accurately by sketching the section on cross-section paper ruled 10 units to the inch. Add up the whole squares and the estimated fractions, as shown in Fig. 4. For blades of uniform section the volume equals the area times the length.

For a uniformly tapered blade find the area at both ends of the missing piece. Let *A* be the area of the small end and *B* of the large end. Then if $R = A/B$, the volume can be closely estimated by multiplying *B* by the length of the missing piece and a factor

K. Pick the value of K corresponding to R from this table:

R	1.0	0.9	0.8	0.7	0.6	0.5	0.4
K	1.0	0.95	0.90	0.85	0.79	0.74	0.68

Next, find the center of gravity of the missing blade length. This fixes the radial distance C, Fig. 1, from the rotor axis. For uniform blade section the cg is at half the length. For a tapered blade, cg is nearer the large end. For the broken or duplicate piece find cg by balancing it on a knife edge. The cg is at the knife edge when the broken piece balances.

When this can't be done figure the position from the ratio R. Distance from the large end to cg for tapered sections will be less than half the length. For uniform tapers, multiply the length by the following factor F^1 corresponding to R:

R	1.0	0.9	0.8	0.7	0.6	0.5	0.4
F^1	0.5	0.48	0.46	0.44	0.42	0.40	0.37

The centrifugal force of the missing weight W is proportional to $W \times C$ and has the units inch-ounces. This missing force must be made up by adding two balance weights, one X at radius A, and the other Y at radius B, in the holes at end of rotor.

Two conditions must be fulfilled to preserve both static and dynamic balance. *First*, sum of the unknown balance weights times their radii must equal the lost blade weight times its radius, or:

$$(X \times A) + (Y \times B) = W \times C \qquad (1)$$

Second condition requires that the product of $X \times A$ times its distance to the blade row must be equal to the product $Y \times B$ times its distance, or:

$$X \times A \times M = Y \times B \times N \qquad (2)$$

By solving equations (1) and (2) simultaneously we come up with the fundamental equations:

$$X = W \times \frac{C}{A} \times \frac{N}{L} \qquad (3)$$

$$Y = W \times \frac{C}{B} \times \frac{M}{L} \qquad (4)$$

We now have the basic formulas. Let's find out how they should be used.

Example: The missing blade portion weighing 12 oz has its cg 45 in. from the rotor axis. Radius of the balance holes for X is 15 in., and for Y 20 in. Plane of the missing blade is 70 in. from X and 30 from Y, making L 100 in. long. Then:

$$X = 12 \times \frac{45}{15} \times \frac{30}{100} = 10.8 \text{ oz}$$

$$Y = 12 \times \frac{45}{20} \times \frac{70}{100} = 18.9 \text{ oz}$$

Proof:

Equation (1) must be satisfied,

$$10.8 \times 15 + 18.9 \times 20 = 12 \times 45$$
$$540 = 540 \text{ in.-oz}$$

Equation (2) must be satisfied,

$$10.8 \times 15 \times 70 = 18.9 \times 20 \times 30$$
$$11{,}340 = 11{,}340 \text{ in.}^2\text{-oz}$$

With this easy method of figuring balance plugs, there's little excuse to balance rotors by cutting out perfectly good blades. Don't repeat the blunder, once made, of placing the balance plugs *opposite* the missing blade and thereby doubling the unbalance!

SEVERAL MISSING BLADES

When two or more blades are missing at different angular positions in the same row, or when several plugs are needed to balance, we use graphical methods to figure the weights and position. This easy method needs a small drawing board, compass, triangles and scale. It consists of reducing several forces acting at different angles to a single resulting force. The reverse can also be done, which is equivalent, in a way, to arithmetical subtraction.

Fig. 1 shows three missing blade portions in solid, with their weights, and radial distance to their centers of gravity. Attempting to balance each blade individually requires a lot of balance plugs, some probably opposing each other. Combining the three forces to a single resultant simplifies the balancing job. The resultant can then be used in equations (3) and (4) as the factor $W \times C$. The three forces are figured as follows:

$$W_1 \times C_1 = 6 \times 45 = 270 \text{ in.-oz}$$
$$W_2 \times C_2 = 8 \times 40 = 320 \text{ in.-oz}$$
$$W_3 \times C_3 = 10 \times 38 = 380 \text{ in.-oz}$$

Each acts in its own radial direction from the center O. The three forces cannot be added arithmetically, since some almost oppose each other. They must be added *vectorially* on account of the angularity. Select a convenient scale, such as 100 in.-oz equals one in., and draw the forces by lines of corresponding lengths radiating from the center and pointing to the respective missing weights, Fig. 1. All drawing must be done with care.

From the end of W_1C_1 draw a line parallel and equal in length to W_2C_2. From the end of this vector draw a line parallel and equal to W_3C_3, arriving at point R, between balance holes 1 and 12. Scaling off the resultant OR we find it equals 420 in.-oz. The resultant acts in the direction shown. The 420 in.-oz figure can be directly substituted in equations (3) and (4) for product $W \times C$ to find the magnitude of weights X and Y to apply in the direction OR between balance holes 1 and 12.

If the single missing blade in the first example, or the final resultant in this case, happens to line up exactly midway between two balance holes, the required weight can be split between them without appreciable error. When the needed compensating weight exceeds what can be put in one or more balance holes, it will have to be divided among several plugs. These must then be distributed over a considerable arc. A graphical method similar to the one described, but in reverse, figures the weight distribution. This is a combination of vectorial addition and subtraction.

Fig. 2 shows a case where the Y correcting weight at the plug-hole radius is 22 oz and falls between balance holes 2 and 3. Maximum plug weight equals only 8 oz each. Several plugs are needed. As often happens, however, balance hole 3 cannot be used because it's already plugged.

Lay out OY to a scale as, for instance, one inch equals 10 oz, thus making the line 2.2 in. long. Hole 2 will need a full plug, so draw its vector 8 oz long from O to $2'$. Since hole 3 cannot be used place another full 8-oz plug in hole 4 and add its vector at the end of $O2'$ parallel to the radius $O4$, which brings us to point $4'$.

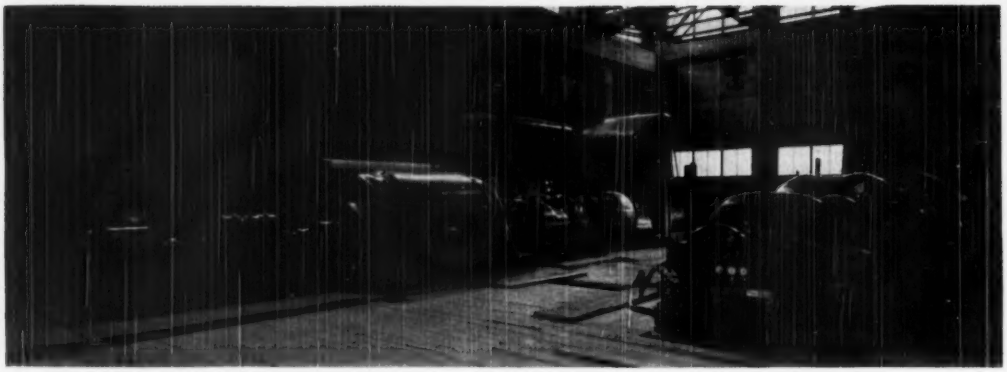
We must select plugs to finally end up at point Y. Place another 8 oz in hole 1 adding its vector to $4'$ parallel to $O1$ arriving at $1'$. Apparently partial plugs in holes 5 and 12 will complete the job. Let's find the right size for each by subtracting the vector sum to $1'$ from the vector OY. This is how it's done:

From $1'$ draw an indefinitely long line parallel to $O12$. From Y draw a line parallel to $O5$ intersecting the previous line at $12'$. Measure the lengths of these lines to find the size of plugs for holes 5 and 12, and the job's done. Let us list the needed plugs as follows:

No. 12	5 oz
No. 1	8 oz
No. 2	8 oz
No. 3	filled
No. 4	8 oz
No. 5	4¾ oz
Total	33¾ oz

The total distributed weight of 33¾ oz yields a net weight of 22 oz at the needed spot.

When missing blades have to be compensated for in two or more rows at different locations it is necessary to figure the balance weights for each row individually. The combined resultant of these individual requirements fixes the final weights needed for balancing.



13,000-KW BROWN BOVERI open-cycle gas-turbine unit in Beznau Station in Switzerland; high- and low-pressure combustors stand near center of picture. Not shown are air and gas ducts under floor and regenerators standing outside of plant

Europe Pushes Gas-Turbine Development

Here are the views of an experienced gas-turbine engineer and designer who has visited important design and manufacturing groups overseas. He gives his evaluation of practical potentialities of closed- and open-cycle units

By **DR P F MARTINUZZI,** *Professor of Mechanical Engineering, Cornell University*

► THESE IMPRESSIONS were gathered during the summers of '48 and '49 in visits to Western Europe. My tours did not include Belgium, Holland, Denmark, Germany and Sweden, who are also doing some gas-turbine development.

Some of the firms visited were reticent about discussing their projects. Others freely gave data on design, tests and even mishaps, but off the record. Europe takes the gas turbine very seriously. It has a greater relative importance as a prime mover there than in the U. S. In England and Switzerland the gas turbine has gained a definite place in the market for prime movers. They are considered competitive in capacities ranging from 500 to about 20,000 kw.

ENGLAND

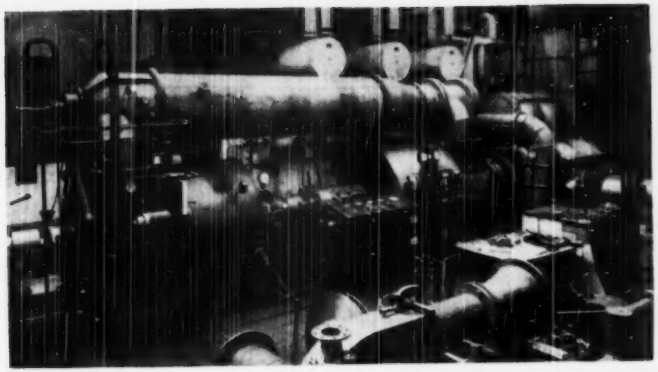
Under the Labor Government, the Ministry of Supply practically controls gas-turbine development. It grants men and materials only to projects meeting its approval. One 12,500-kw and two 15,000-kw units under construction for the British Electricity Authority show the Ministry has full confidence in the gas turbine. Even more significant are the three 2000-kw units ordered from three different manufacturers by the Metropolitan Water Board of London. This notoriously conservative board uses the units for standby pump drives. Undoubtedly these orders have been approved by the buyers and the Ministry of Supply because they think them the best solution for the service needs. They were not placed to favor gas-turbine development.

The British coal shortage has undoubtedly helped the gas turbine. Interest in gas-turbine locomotives by the railways arose when many coal-fired engines were converted to oil to save coal. Simplicity and conservatism mark industrial turbines now under construction. Large capacities use open-cycle arrangements with reheat and considerable regeneration. The 12,500-kw Dundee unit, built under closed-cycle Escher-Wyss license, is the exception.

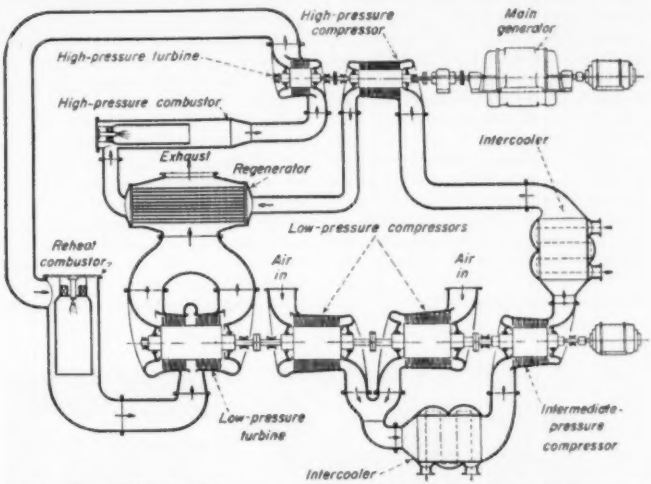
Aircraft turbine practice has had much less influence on industrial units than anticipated. Single-combustion chambers are generally used and maximum temperatures kept down to about 1200 F. Apparently they aim to build reliable machines rather than obtain spectacular performance.

New Unit. The 750-kw set built by Ruston Hornsby Ltd. gives good test reports. Installed in the builder's factory, the unit has a 13-stage axial compressor, driven at 11,400 rpm by a 2-stage high-pressure turbine. The 2-stage 6000-rpm low-pressure turbine drives the generator through a 4:1 reduction gear. The turbine shafts are in line. Turbine rotors are air cooled. The single combustion chamber and heat exchanger stand under the compressor and turbines. The builder normally produces agricultural machinery and diesel engines; they had no previous experience with turbines of any kind.

The locomotive gas turbine being built by the English Electric Co shows the tendency toward higher temperatures. It has a combined axial and centrifugal compressor with a single centrifugal stage on the high-pressure side. Air cooling of the turbine rotor has been studied with particular care. This, in combination with high-quality materials for the uncooled turbine



1000-KW OERLIKON open-cycle gas-turbine unit has multi-diffuser centrifugal compressor at right. Reheat combustor takes horizontal position above two turbines



27,000-KW BROWN BOVERI open-cycle gas turbine features two low-pressure compressors in parallel and double-flow low-pressure turbine to handle high flow rates

blades, anticipates the use of 1470-F inlet temperature. No test data have been revealed. Turbines now on order or being designed will probably work at about 1320 F.

Centrifugal Compressors. English Electric Co. Rolls-Royce and others are building turbines for the British Navy. There is a tendency, however, to wait for further experience on land before using them at sea. Swiss influence on British design, already strong through emigration of technicians, is increasing. John Brown, Ltd, is building the 12,500-kw Dundee unit under Escher Wyss license and design. This closed-cycle set is very similar to the one built in Switzerland for the St. Denis station near Paris. Centrifugal compressors are used on the high-pressure side. British Thomas-Houston has bought the Oerlikon centrifugal compressor license. Since the Whittle tradition favors centrifugal compressors, it is likely that a revival will see these applied to industrial units.

The centrifugal's large diameter, which has been its main disadvantage in aircraft, has little importance in stationary turbines. Units for special applications, such as peat burning, coal firing or utilization of high-temperature waste heat from gas works, are being studied. For all these, the closed cycle seems best suited.

Cooperation. During the past few years the National Gas Turbine Establishment at Lutterworth and Pyestock has exerted considerable influence on British gas turbines, both aircraft and industrial. It has contributed considerably to research and development and had a strong unifying effect on British gas-turbine practice. Services and advice of NGTE are available, free, to all British manufacturers. They, in turn, keep no secrets from the Establishment. Lately, however, NGTE has been devoting more of its activity to the scientific side. Engineering work and liaison with manufacturers is not as close as formerly. Probably many manufacturers have gained considerable experience and no longer need constant advice.

SWITZERLAND

All four major Swiss manufacturers —Brown Boveri, Sulzer Brothers, Escher Wyss and Oerlikon—are still busy testing, developing and improving their various industrial units. Though the firms are not large by American standards (2000 to 8000 employes) each has spent large sums, some running into millions of dollars, on gas-turbine development. They have had no help or subsidies from their government. At best they will be able to recover development costs only after many years. Accidents and unforeseen circumstances often increased the cost of some projects well beyond original estimates.

The Swiss retain in full their faith in the gas turbine's future. They feel the money spent gives them added experience in a field they were the first to explore and in which they intend to maintain the lead. Swiss industry depends on exports, though handicapped by high costs from a high standard of living and by lack of raw materials. It can only keep its share of the export market by being in the forefront. The industrial gas turbine in their opinion is the most promising field.

Nevertheless, there has been a change of attitude. Up to a few years ago immediate commercial possibilities of the gas turbine were extolled. New plans and projects were optimistically bandied about and new contracts eagerly sought. Now a much more sober attitude prevails. There's a certain reluctance to undertake new commitments until thorough tests are concluded and all experience with the units digested. Though engineering, development and design are actively pursued, no final decisions will be made for some time.

The four Swiss firms continue their keen rivalry. There's no apparent sign of pooling efforts or knowledge, though this might be justified by small size and proximity of factories. The traditional brisk competition stimulates inventive-

ness and has some commercial advantages. This results in a greater diversity of gas-turbine designs than in any other country. There's one common characteristic in all Swiss gas turbines: They have been conceived and developed from the beginning as commercial power plants by firms with considerable steam-turbine experience. There's no trace of aircraft influence. As a matter of fact, Swiss firms are not interested in the aircraft market. One is studying large jet engines for the Swiss army, but is mainly interested in acquiring experience in lightweight design for marine use.

Beznau Station, Nordost Schweizerische Kraftwerke, with two open-cycle high-efficiency Brown Boveri units (13,000 and 27,000 kw) has been working under test over a year. Built to produce energy during winter water shortages, the very dry winter of '48-'49 gave ample testing opportunity. The 13,000-kw unit started its tests at the end of August 1948 after some initial trouble with turbine-blade material. Tests were continued till mid-January 1949 for a total running time of 1478 hr. By this time a crack was found in one of the welded rotor disks. Rotors of both turbines were redesigned and rebuilt.

In mid-February, the tests were resumed for another 756 hr until the beginning of April. Testing was interrupted to fit an air filter. Nearby brick and cement factories evidently caused dirt deposits on blades of the high-efficiency compressors, sharply reducing their performance. From the end of April, unit was run till the end of May for another 190 hr. Up to the summer of '49, it ran 2711 hr generating 26,326 mwhr.

The 27,000-kw unit started at the end of January 1949. After 327 hr operation, fire broke out in a heat exchanger while the unit was out of service. Repairs took a month and a half. From end of March till summer it ran 272 hr. In total it ran 599 hr, producing 8893 mwhr. During the summer of '49 a permanent air cleaner was installed. The high sensitivity of very efficient axial compressors to dusty air was noticed by other Swiss firms during tests. Filtering air flow to the Beznau turbines is no small matter. Air-fuel ratio equals about 50:1 giving a flow of about 300 lb per sec. The permanent air cleaners, placed outside the building, are very large.

Brown Boveri is now pursuing further tests on the Beznau units. They do not plan publishing results until the station has run for considerable time. Both Beznau units are twin-shaft with reheat, working at a maximum temperature of 1160 F. Low-pressure turbine drives the low-pressure compressors. High-pressure turbine drives the high-pressure compressor and the generator.

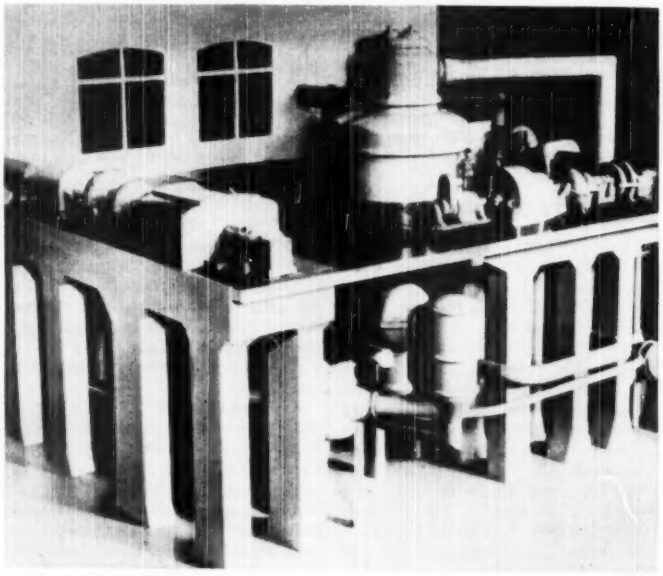
In the 13,000-kw set the power turbine runs at about 4800 rpm driving the 3000-rpm 50-cycle generator through a reduction gear. Turbine of the 27,000-kw set runs at 3000 rpm with no need for reducing gears. While the turbines, compressors and combustion chambers are moderately large, the heat exchangers are enormous. Machinery in the main hall looks simple and neat. Intercoolers and the very extensive air and gas ducts are in the cellars. They are of tremendous size, following an intricate and long path with many changes of direction. Pressure losses must be far from negligible.

These large units seem to be near the maximum for open-cycle units, at least until temperatures are substantially increased. It would not be surprising if future installations were limited to lower capacities and simpler design, particularly in regard to heat exchangers and air ducts. Experience with this station will be of great value to the manufacturers.

Apart from the difficulties mentioned, the units have run satisfactorily. Some of their features show the advantage of gas turbines. They can start from cold in 15 minutes, a needed attribute for reserve units. Control is simple and operation quiet. Combustion is excellent with the fuel, "Heizoel III", a cheap, dense oil used for heating in Switzerland. Bunker C is not readily available. Future turbines will probably have their temperature raised to at least 1300 F.

Oerlikon. The other Swiss version of the open-cycle gas turbine is the 1000-kw Oerlikon experimental unit. It has been running since 1946 in the power plant of the builders. Its features include a multidiffuser-type centrifugal compressor and a combustion chamber in which fuel is injected at a low pressure by a low air-pressure differential working on a float chamber. Power and compressor turbine are separated and independent. The unit has proved extremely reliable. It has been delivering power to the factory and to the Zurich distribution system every winter since 1946. Small quantities of Bunker C oil, tried on two different occasions, worked satisfactorily.

Turbine exhaust gas has been successfully used in place of air in the plant's steam boiler furnace. Gas temperature varies from 260 to 390 F after leaving the regenerator. In this way the gas turbine can increase the capacity and efficiency of existing steam plants. Tests are under way to improve still further the performance of the multidiffuser centrifugal compressor. It is hoped the same high efficiency and flat characteristics will be obtained with a new radial-vane rotor at higher peripheral speeds so the pressure ratio per



12,500-KW ESCHER WYSS closed-cycle unit for St. Denis station, near Paris, features application of both axial and centrifugal compressors; uses reheater also

stage will be raised for future designs.

Escher Wyss has nearly finished the 12,500-kw closed-cycle unit for the St. Denis power station near Paris. A similar unit is being built under license by John Brown Ltd for Dundee. A recent paper, by Dr Curt Keller before ASME (No. 49-A-35), describes these units fully. They use reheat, which fits in nicely with the closed cycle, because one air heater can carry both high-pressure and low-pressure air tubes. The former, being less highly stressed, are in the hottest part of the heater, shielding the latter somewhat.

An open-cycle gas-turbine charging set compresses combustion air to 45 psig. Resulting increased heat-transmission coefficient considerably reduces the air-heater size. Basic pressure of the closed cycle at full capacity is 65 psig and maximum pressure 750 psig. Maximum temperature is 1250 F. Varying the basic pressure by special compressors varies the output. A bypass on the power turbine controls small output variations.

Most notable improvement in mechanical design is the centrifugal compressors for the high-pressure stages. The highly efficient heat exchanger is extremely compact because heat-transfer coefficient is high and because having only clean air on both sides of the tubes allows small diameters, about ¼ in. High regenerator effectiveness explains the exceptional efficiency of 36% expected of these units. The closed cycle in itself has no advantages thermodynamically over the open cycle. It does have the advantage of more compact equipment because of the higher basic pressure.

Escher Wyss is studying the burning of pulverized coal in the air heater. This appears the most promising way of burning coal in a gas turbine. Combination of a radiant-type coal-burning air heater and centrifugal compressors should result in compact and economical gas-turbine plants. Tests of the St. Denis unit should begin this year.

Sulzer Brothers has two semiclosed-cycle units under tests—the 7000-hp experimental marine unit built in 1948 and the new 20,000-kw set at Weinfelden power station of the Nordost Schweizerische Kraftwerke. This station, like Beznau, must produce energy during the winter months at an efficiency of about 34%. The Sulzer semiclosed cycle has some of the advantages and disadvantages of both open and closed cycles. High basic air pressure in the main turbines allows compact machines. High air density on both sides of heat-exchanger tubes gives excellent heat transmission. Part of the air, however, is continually renewed and, in the long run, this might cause tube and compressor blade fouling.

No air filter is planned at Weinfelden. Air-intake cross section is very large causing a low intake velocity. It is hoped that dust in the air will settle out before entering the compressor. Air consumption in the unit is much smaller than an equivalent open-cycle turbine. Compression ratio in the closed part of the cycle is about 4:1, in the power turbine about 7:1. Maximum temperature reaches 1200 F.

Because combustion gas outside the tubes and air inside are at the same pressure, the air heater can be made very compact. This also relieves the tubes of mechanical stresses. Varying the basic pressure of the cycle regulates power output without using special compressors and tanks. Size and extent of control apparatus shows regulation to be one of the main problems of these turbines. On the other hand, compactness of the main equipment gives a very reasonable station size.

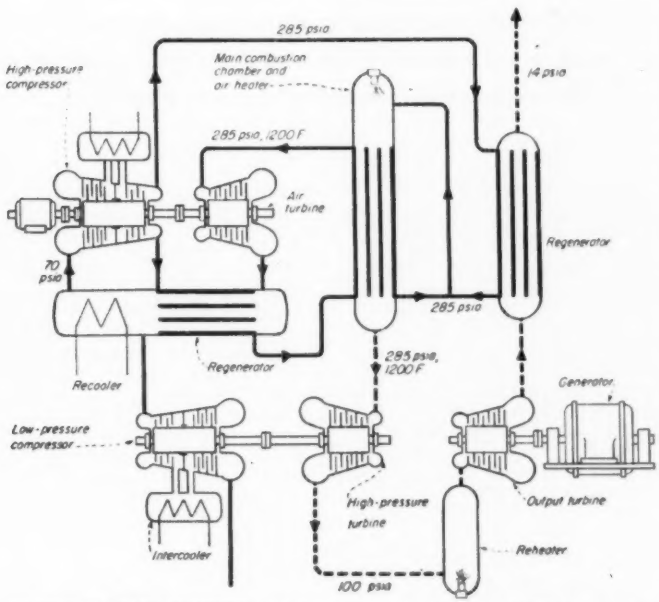
Tests of the Escher Wyss St. Denis plant and the Sulzer Weinfelden station give highly interesting comparative data since both are designed for similar efficiencies and conditions. If these tests are successful, which is very likely, there will be a strong revival of interest in these cycles. Higher efficiency and compactness compensates for the increased design complications. Future of these complicated cycles depends on the progress in high-temperature materials and blade cooling. These are stimulated by the needs of aircraft gas turbines, but will be reflected in industrial gas turbines.

Temperature increase makes conditions more severe in the most delicate part of these cycles, the air heater. On the other hand, the greatest disadvantage of the open-cycle turbine, tremendous volume of air per hp, rapidly diminishes with rising temperature. Limit above which the open cycle becomes the best lies at about 1650 F. Future of the closed and semiclosed cycles depends on the time it will take before such temperatures can be used normally for commercial gas turbines. It's likely that at least 10 to 15 years will be needed to achieve this result.

Even now, the closed and semiclosed cycles are only justified for relatively high capacities and highest efficiencies, or for special applications, such as coal burning, atomic energy or waste-heat recuperation. The closed cycle seems best for all of the latter. Sulzer Brothers is already considering the semiclosed cycle purely for these purposes and is prepared to use the open cycle whenever considerations of weight justify it or very high efficiencies are not required.

All four Swiss firms are doing intensive research and development work. They prefer to raise their over-all efficiencies by increasing compressor and

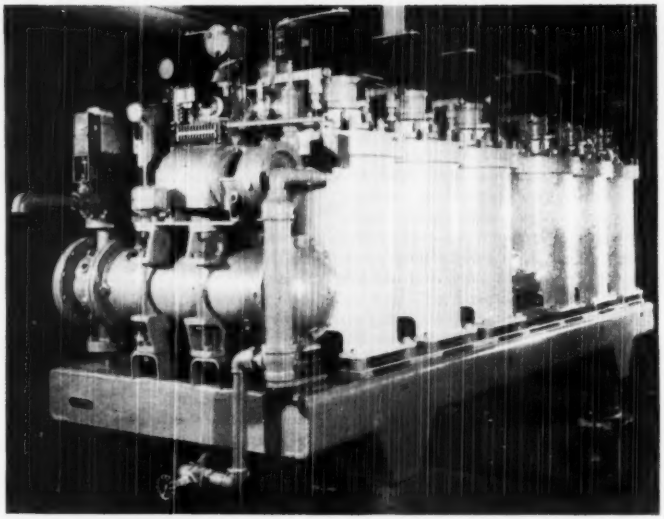
(*Continued on page* 186)



20,000-KW SULZER BROTHERS semiclosed-cycle gas turbine for Weinfelden station, Switzerland, has closed high-pressure air heater, open low-pressure combustor

Follow These Steps If Arc-Backs Continue

1 Make sure rectifier trip-outs are caused by arc-backs
2 Check which anode is responsible for each arc-back
3 Check current balance in main anodes
4 Make insulation test with megohmmeter
5 Make seepage test for tight tank
6 Check the interphase transformer and its voltage wave-shape
7 Hook-in oscilloscope to check wave-shape of anode-to-cathode voltages, anode currents, grid-to-cathode voltages and currents
8 Check oscillograms at time of arc-back
9 Investigate ac and dc circuits
10 Open tanks for inspection
11 Check breaker and relay speeds before returning unit to service



PUMPED-TYPE EXCITRON rectifier with 12-phases from power transformer secondary feeding finned-anodes. Arc-back probability is less than 1 in 23 billion cycles

Spotting the Cause of Arc-Backs in

Arc-backs are commonest type of rectifier failure. Several practical methods, and a step-by-step procedure, are outlined for tracking down their cause, with emphasis on usefulness of the oscillograph*

► ALTHOUGH THE MERCURY arc rectifier is a fully accepted and reliable machine, internal faults do crop up from time to time. Commonest failure is the *arc-back*, sometimes called a backfire. An occasional arc-back is no cause for alarm where a rectifier is being used properly and has proper relay protection. Almost anything that can go wrong with a mercury arc rectifier, or its associated equipment, eventually induces an increase in the arc-back rate. While the harm done by any one arc-back is slight, the damage is cumulative.

Causes Before diving into a full-fledged discussion, let's review the direct and indirect causes of arc-back. By definition, an arc-back is a failure of the check-valve action of a rectifier; thus it permits a reversal of current flow between cathode and anode. Another way to look at it is that at time of arc-back the anode emits electrons and becomes, in fact, a cathode. This might be caused by many things, such as poor vacuum, overtemperature, overloads (including those due to unbalance), high inverse-voltage, voltage surges, poor insulation, foreign material on the anode, etc. In a nutshell, an arc-back is really an unbalanced short circuit across the secondary winding of the rectifier transformer.

An arc-back itself is not visible. We depend solely on external signs, such as tripping of circuit breakers, to announce its occurrence. With few exceptions, industrial rectifier installations include a cathode or an anode breaker, or possibly both; this is in addition to an ac breaker. If the dc machine breaker trips only on reverse current, and the dc system is capable of feeding back, opening of this dc breaker of the load is generally the signal that an arc-back has occurred. Nevertheless, it pays to check further to insure that the breaker's tripping was not a mishap of the control and protective systems.

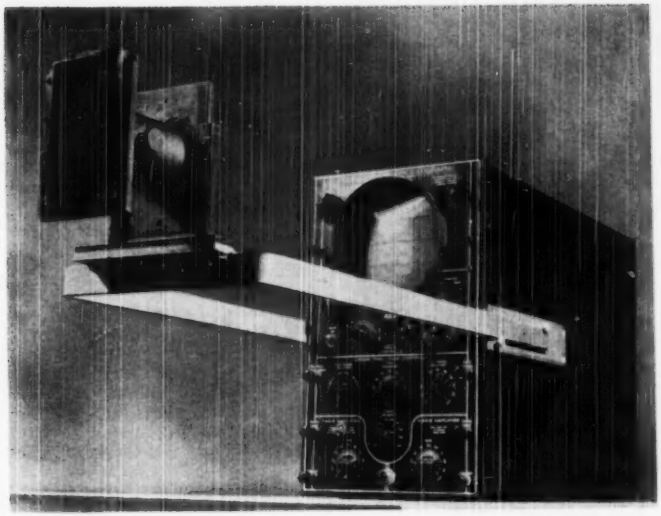
Poor vacuum is another symptom Vacuum trouble may be caused by a leak, loss of pumping capacity, or the presence of foreign volatile matter in the vacuum system. This symptom calls for immediate investigation since, if allowed to continue, it will result in rapid deterioration within the rectifier.

Abnormally high or low temperatures may also lead to arc-backs. Wide variations in temperature between anodes or anode cables are one indication of a severe current unbalance, which is conducive to arc-back.

Another danger signal is high transformer temperatures. They may be caused by overload or failure of interphase transformer. It is quite possible to saturate the interphase transformer by anode unbalance or a short circuit in the interphase winding. These generally produce arc-backs.

Another thing to look out for—really, to listen for—is a marked change in the noise produced by the transformer. This change in noise should not be con-

* This article was prompted by I. K. Dortort's recent AIEE paper, **Diagnosis of Rectifier Ailments.** At the time this paper was presented the author was with the Allis-Chalmers Mfg. Co. He is now connected with the ITE Circuit Breaker Co.



CATHODE-RAY OSCILLOGRAPH has automatic camera attached; retains image that was on screen at time of fault. Eliminates need for sitting up with a sick rectifier

Mercury Arc Rectifiers

fused with that caused by change in load. Noisy anode-balancing reactors generally indicate poor anode current balance. Sharp clicks or thumps indicate excitation failure or misfires. An arc-back in itself also causes a sharp noise in an anode balance and reactor. But it is generally drowned out by the noise of the breakers opening unless the arc-back is cleared by arc suppression without operation of the breakers.

Symptoms described above can be observed without special equipment. There is another list of symptoms that require specific instruments to spot. Such symptoms are deviation from the normal of the following: anode current balance, anode-current wave-shape, anode-to-cathode voltage wave-shape, grid current wave-shape, internal insulation resistance, and wave-shape of grid-to-cathode voltage along with the interphase transformer voltage.

Spotting the Trouble. Probably the best way to illustrate the how-to phase of an investigation is to take a typical trouble case and follow step-by-step procedure to get at the cause. Assume your rectifier has been operating satisfactorily all along, averaging less than two or three arc-backs per year. Over the last few months this rate has increased to two or three per month.

In each case the breakers have reclosed automatically so there is not as yet any serious interference with operation. But each outage seems to occur during the peak-load period. Should the outage rate continue to increase, serious service interruption is bound to occur. Assume there are no operators in attendance at the rectifier, and the only fact is that an unscheduled circuit-breaker operation took place. In each case targets are found on the ac overload relays after each interruption.

Breaker Operation. First step then is to determine whether the outages are really caused by arc-backs. The dc circuit breaker is equipped with a built-in reverse current trip and a shunt-trip coil. Only indication on the annunciator (if one is used) is an indication of an unscheduled opening of the circuit breakers. Vacuum, temperature and all other observable conditions have been checked and found okay. So it is a logical assumption that the outage was caused by an arc-back.

Anode Current Balance. Your next check is to see that the anode currents are balanced. A good rough check can be made with a split-core ammeter. Yes, this is somewhat inaccurate, but it is fast and convenient. If greater accuracy is desired, a dc millivoltmeter can be used if suitable sections of the anode connections are accessible. Load has to be reasonably steady while this balance check is made. Now let us assume that anode current balance is okay at high and low loads. Next step is to find the anode that's arcing-back.

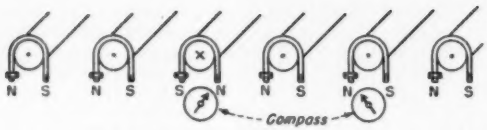
Arc-Back Distribution. A common U-bolt can hardly be classified as a scientific instrument, Fig. 1. But when used with a compass it will give a quick check on which anode has arced-back. This trick requires one U-bolt tied to each anode cable. During normal operation anode currents magnetize the U-bolts in one direction. During an arc-back a heavy reverse current flows in the faulted phase and reverses U-bolt polarity. This reversal of polarity is spotted with an ordinary compass. Incidentally one end of each U-bolt should be marked so no mistakes will be made when they are removed for checking.

To get some measure of the arc-back current a surge-crest ammeter is more suitable than the U-bolt rig. Complete surge-crest ammeter consists of a magnetic link, indicating instrument, and demagnetizing coil, Fig. 2. Magnetic link is held against anode cable with a nonmagnetic material. After an arc-back each link is removed and checked with the surge-crest ammeter for magnetic polarity and magnetic strength.

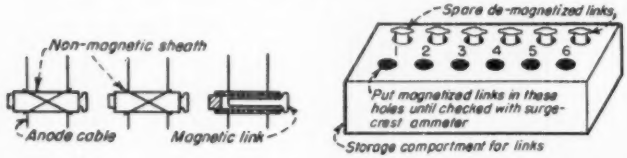
Arc-Back Detector. If arc-backs become too frequent it may be practical to install an arc-back indicator, Fig. 3. This device lights a signal-lamp corresponding to the faulty phase. Indicator consists essentially of a number of thyratron tubes, six for a 6-phase rectifier, twelve for a 12-phase unit etc, and a small dc power supply. Current transformer on each anode lead runs to the grid of a tube. Tubes are normally blocked. When an anode arcs back the ct in the faulted phase produces a positive impulse on the grid of its corresponding tube. Resultant current flow to the common cathode resistor increases the bias on all other grids. As a result, all tubes except the one that is triggered remain blocked. That tube continues to fire until reset. The plate current is then used to light a small signal lamp in front of the cabinet.

Coming back to our running account, let's say we tied down the trouble to anode No. 5. Cause for the arc-backs on this anode is yet to be determined.

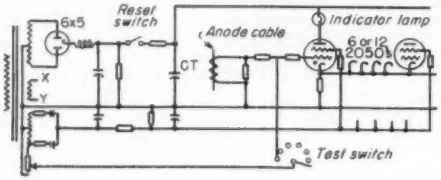
Using Oscillograph. A few general remarks are in order on the cathode-ray oscilloscope. First off, it should be tried in several different positions to find if image is being affected by stray fields. Twisted leads help a lot in avoiding stray pickups. Whenever possible the oscilloscope should be used in a grounded circuit and connected across the grounded end of a poten-



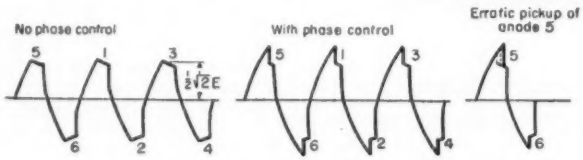
1 U-bolt and compass make practical rig for checking which anode is arcing back. Bolt is slipped over anode cable; polarity is different on arc-backed anode


Non-magnetic sheath
Anode cable
Magnetic link
Spare de-magnetized links
1 2 3 4 5 6
Put magnetized links in these holes until checked with surge-crest ammeter
Storage compartment for links

2 Anode that arc-backed can also be found with surge-crest ammeter. Magnetic link from each anode lead is checked by instrument for reversed magnetic polarity



3 Electronic arc-back indicator eliminates the anode U-bolts and magnetic links. Suited for indicating which anode arc-backed if bolts and links are impractical



4 First step in 'scope analysis is checking for any irregularity in anode firing by tapping across interphase transformer. Both patterns to left are normal

tiometer if voltage is high. Often these conditions can't be met in practice. Nevertheless, it is wise to place the oscilloscope on an insulated table and operate from an insulated stool or mat. When used on rectifiers over 250 v, it is well to take oscilloscope power supply through insulating transformer.

A good starting point for the scope is to check any dissymmetry in anode firing. Easiest way to do this is to "picture" the wave-shape across the interphase transformer. Just to get you oriented, look up at Fig. 4 for an idea of normal- and erratic-wave shapes at interphase transformer.

A quick way to identify an anode on the scope is by disconnecting, momentarily, each anode grid—one at a time. When disconnected, the leading slope of one of the loops will continue forward. In fact, it will pass the point where it normally breaks to complete a sine wave. The point where this particular curve normally breaks is the point where the anode that was disabled would normally have picked up. Another way to make this check is to determine the pick-up point of a given anode from its voltage or current wave.

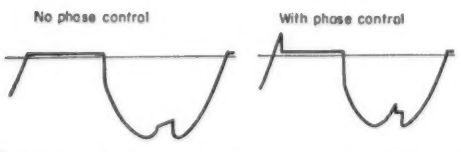
Marked differences between the positive and negative loops on scope indicate dc saturation of the interphase transformer. This is generally caused by an unbalance between the two 3-phase systems. A noticeable reduction in the amplitude of either positive or negative loops, or both, might be caused by one or more shorted turns in the interphase winding. Peak voltage across the total interphase winding, without phase control, should be exactly one half of the peak voltage of the transformer secondary phase to neutral voltage.

General comments at this point show why the interphase transformer voltage offers an excellent advantage for a quick over-all check on the operation of the rectifier. Of course, it is not always practical to make this check because the interphase transformer terminals are not readily accessible.

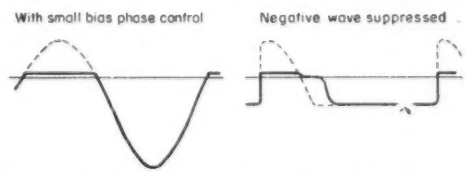
Among the most revealing checks made on a rectifier itself are the wave-shapes of the grid-to-cathode voltage and grid current. Comparison of the grid-to-cathode voltage reveals any discrepancy in the grid circuit, whether internal or external. This point is further elaborated on in Fig. 6, 7 and 8.

Megohmmeter Test. This instrument is used here primarily to test the internal insulating members of the rectifier. When making this check, any external connections — electrical and water, which might influence the reading—should be removed. Such tests are made between anode and tank, grid to tank, tank to cathode, and tank to

OSCILLOSCOPE TRACES OF ANODE AND GRID VOLTAGES ALONG WITH GRID CURRENTS



5 Anode-to-cathode voltages. Note how any variation in phase control of the main anode shows up in start of each wave



6 Typical grid-to-cathode voltages. Sinusoidal voltage was applied to grid, *left;* chopped voltage wave used, *right*

cooling coil, where the rectifier has an internal cooling coil insulated from the tank. Actually, the value of insulation measured for these components is a function of design and service. But significant differences in insulation resistance between anodes of the same rectifier and between rectifiers of the same type should be investigated.

Seepage Test. Again, we'll assume that all results have been negative up to this point. Then you'll want to shut down the rectifier for a seepage test. In a nutshell, this means a check on how tight the tank is. For dependable results, seepage rates should be averaged over at least six hours. The machine must be held at constant temperature, preferably room temperature, throughout the test. And this means the rectifier will be out of service ten to twelve hours. A McLeod vacuum gage is generally used when making a seepage test.

General seepage procedure for single-anode rectifiers is as follows: (1) Cool rectifier to room temperature, allowing enough time for internal parts to cool. (2) Pump rectifier down to its best vacuum. (3) Close individual manual vacuum valves on rectifier tanks and the main vacuum valve. (4) After a period of not less than six hours take a reading of the vacuum in the vacuum header. Pressure rise in the header should not exceed 5 microns per hr. (5) Open main vacuum valve and restore good vacuum in the header. (6) Close main vacuum valve. (7) Open valve on one tank. After five minutes read vacuum on McLeod gage. Pressure increase divided by the number of hours the tank valve has been closed is about the average seepage rate. Close tank valve. (8) Repeat steps 5, 6 and 7 for each tank in turn.

Generally speaking, the permissible seepage rate is based on previous experience with a particular design of machine. Correct value can best be obtained from the manufacturer. As a rule of thumb, we can say that a seepage of 0.5 microns per hr is the maximum permissible. But any increase in seepage rate on a given tank should be investigated.

Naturally, no direct seepage test is possible in the case of a sealed-arc rectifier. Where glass seals are used and the light of the arc can be observed through them, a pinkish glow indicates a leaky tube. Another check is that the excitation arc of a continuously excited rectifier will be unstable without aid of the main arc when vacuum is bad.

Oscillograms Under Fault. Once again let us assume that all checks and tests up to this point have produced negative results. It won't be easy to justify a further shutdown at this point, so the rectifier is returned to service for further observation. The thinking here is that progressive deterioration produces more definite clues before serious damage is done. Before going back in service, check the over-all breaker speed, including relay time, to make sure slow tripping will not cause serious trouble within the rectifier if another arc-back occurs.

Go a step farther at this point and get oscillograms under actual fault conditions. To be of any value, these oscillograms must show not only the fault itself, but also what occurs immediately preceding it.

It is at this point that the scope with a camera attachment comes into the picture. This retains the image that was on the screen at the time of the fault. Because of the retentivity of the oscilloscope screen, it is not difficult to photograph the image that was projected on the screen a cycle before the shutter actually opened. This is handled by having the actual fault trigger the camera shutter.

Final Steps. Just to make it rough, we chose a difficult case for our example. Three more steps remain, the choice depending on circumstances. First, there is the matter of opening the tank for inspection and overhaul. Of course, the tank to open should be the one with the poorest record.

Second, if there is a reasonable doubt that the trouble is internal, interchange the tank that has the most arc-backs with one of the others. Third, if spare tank and bake-out equipment is available, interchange with each tank on the frame. This should be done, one at a time, until the faulty tank is found by elimination.

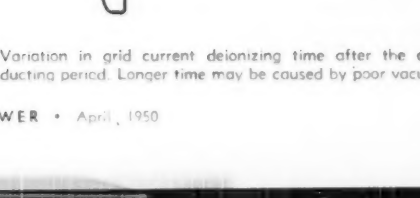
But before starting out on any elaborate program of investigation, it is best to use first the simple tests outlined at the beginning of this article. Actual order is determined largely by service requirements. Load division, seepage and megohmmeter tests are basic and should be carried out as soon as trouble is experienced. Any of these might lead to the source of trouble and indicate the remedy.

In particular, the seepage and insulation tests are likely to determine at once whether the trouble is in the rectifier itself or in associated equipment. Of course, a poor seepage test means a leak has been found and must be corrected. Often this requires opening the rectifier. On the other hand, low insulation-resistance results invariably mean opening the rectifier to restore proper insulation level.

In general, the trouble-shooting sequence outlined is not fixed. Some steps may be eliminated and others added depending on local conditions. But generally speaking, checking relay and breaker speeds should always be included as a matter of routine.

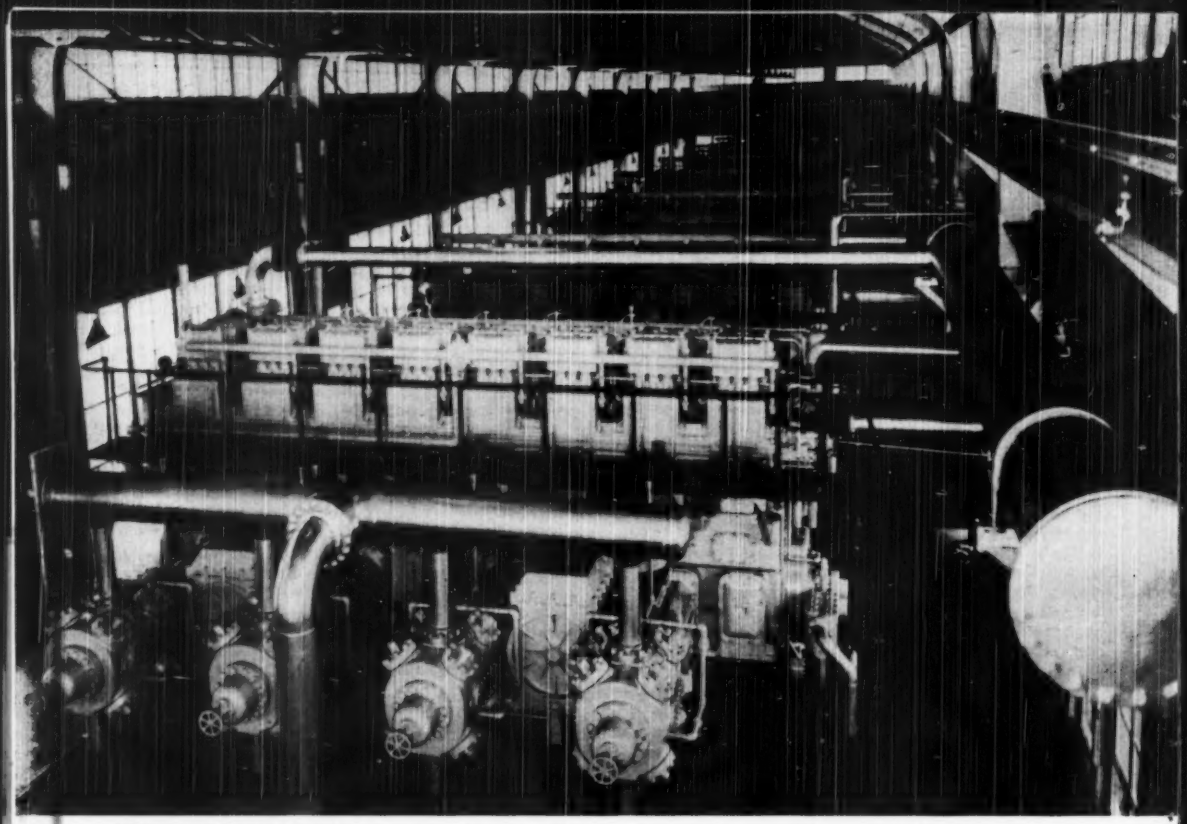
Let's not get the impression that this article pegs the mercury arc rectifier as an unreliable machine. Actually, a very improbable set of coincident phenomena have to occur to produce a failure. And if this sounds far-fetched, let's consider the tremendous number of anode-cycles that pass without incident between faults. A 12-anode rectifier, with a bad record of one arc-back per day, is averaging one bad anode cycle in 62 million.

Nevertheless, improper operating conditions and internal disorders must be diagnosed and corrected early. And it is mighty important to the user that it be done with the least loss of service and minimum expense.



7 Variation in grid current deionizing time after the conducting period. Longer time may be caused by poor vacuum

8 Grid current for sinusoidal voltages shows changes with phase control. Any deviation between tanks bears checking



ENGINE-COMPRESSOR UNIT, in foreground, has eight 16×16-in. power cylinders, two scavenging cylinders and four compressor cylinders. At 320 rpm and with 77-psi, bmep, engine is rated at 1600 hp. Tests reveal high overload capacities

New-Type Gas Engine Installed on

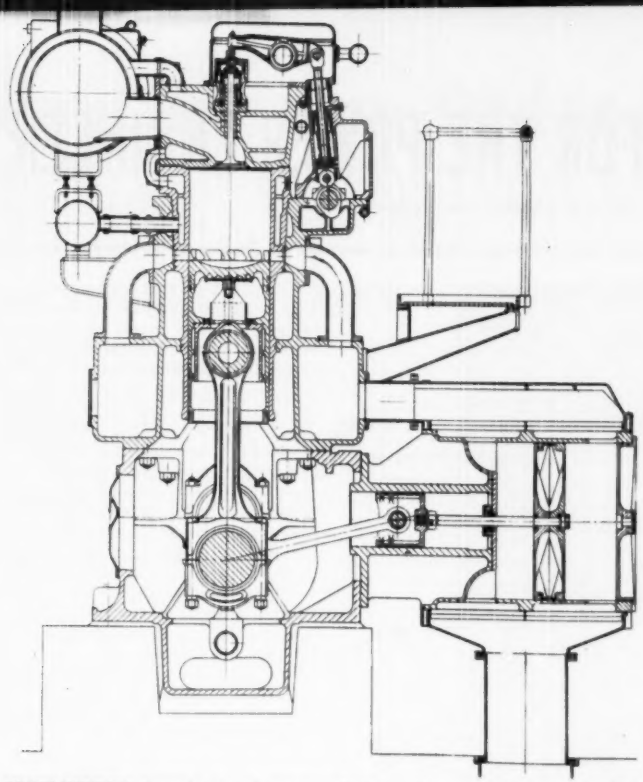
Spark-ignition, 2-cycle, engine-compressor unit rated at 1600 hp, now operating in a station of the Tennessee Gas Transmission Co, has:

- **Uniflow scavenging with cam-operated exhaust valves in cylinder heads**
- **High-compression pressure for low fuel consumption**
- **Mechanical design incorporating removable cylinder liners with water jackets cast in and bolted wristpins**

► RECENT ADDITION of a 1600-hp engine compressor set, at the West Monroe, La. station of Tennessee Gas Transmission Co, points up the apparent trend to re-evaluate and redevelop the spark-ignition engine. Compared to other fuels, natural gas is now in a favorable position in many parts of the country. More use is being made of byproduct gases, such as sewage gas. Need for gas-engine compressor sets (and for gas engines) has multiplied with the growth of natural-gasoline extraction, recycling, petro-chemical processes, and pipeline transmission of natural gas.

Otto Cycle Again? With the focus on gas as an engine fuel, development has been rapid in the past five years. From gas-diesel and dual-fuel engine developments, builders have learned much about handling gas in internal-combustion cylinders and have shed some restrictive ideas about gas-air mixtures growing out of past otto-cycle experience. Recent developments indicate a desire to apply some of this new thinking to the spark-ignition engine in the hope of gaining high efficiency without need for oil injection or compression pressures in the full diesel range.

Uniflow Scavenging. The 2-cycle engine at West Monroe reveals some of this new thinking on an old cycle. Principal features are higher compression pressure than formerly thought possible, and uniflow scavenging with inlet ports in cylinder walls and cam-operated exhaust valves in cylinder heads. Out of extensive research on the Kadenacy principles, and wide experience with dual-fuel engines, the builders (Worthington Pump & Machinery Corp) turned to straight-through scavenging for these reasons: (1) Exhaust timing depends on cam-operated valves and not on piston position, hence can be adjusted to give greater exhaust area for blowdown before intake ports uncover. This facilitates removal of combustion



CROSS-SECTION through typical power cylinder and a scavenging-pump cylinder shows scavenging-air manifolds each side of engine, inlet ports, exhaust valves

Gas Transmission Line

products. (2) Larger volume of scavenging air may be used, with lower air pressure because of greater area. (3) Earlier exhaust closing is possible, which permits an appreciable degree of supercharging.

Higher Compression. Increased blowdown, supercharging and air flow in a straight line result in charging the cylinder with a greater weight of air so higher mean pressure can be developed without higher temperature. Furthermore, proportion of pure air in the total is increased. These factors, plus careful avoidance of design features that would encourage pre-ignition (such as local hot spots), make it possible to operate at higher compression pressures —about 280 psi compared with 150 in conventional gas engines.

Inlet ports occupy the entire circumference of the cylinder wall, receiving scavenging air from manifolds on each side of the engine (see cross-section above). This helps keep lower part of cylinder wall cool and avoids temperature differentials existing when exhaust and intake ports are close to each other. Upper end of cylinder and head are exposed only to normal 2-cycle exhaust heat, lowered by greater scavenging. This reduces stress in the cylinder heads. All these factors help to permit high ratings without excessive temperature strains and explain why engine tests showed unusually high overload capabilities.

Cylinder Liners. Engine construction shows a number of interesting elements. The cylinder liners, which are removable, have water jackets cast into them. Low temperatures at bottom end of cylinder permit eliminating water cooling below inlet ports. With this design, only sealing needed on liner-to-frame fits is at the ports. Top seal holds low-pressure scavenging air while the lower one prevents escape of oil splash.

Wristpin Bolted. Wristpins are carried in a separate piece bolted to a transverse wall in the piston. This gives pistons unbroken outer walls, avoiding strains caused by wristpin fit and preventing unequal heat stresses.

For piston cooling, oil is forced through an annular space between wristpin carrier and outer wall to a series of circular grooves on under side of piston crown. From there it is ejected through a series of radial slots in a fine spray against inner piston wall, back of the rings. An annular partition maintains an oil level at a point close to the bottom ring. This volume of oil helps prevent carbonizing after engine stops running.

Exhaust Valves. Each cylinder head has two exhaust valves, driven by separate rocker arms. Valve gear, camshaft and spur-gear camshaft drive are of conventional 4-cycle type, completely forced-feed lubricated. Cone design of cylinder heads gives high strength and greater freedom from expansion strains. Joint between head and cylinder is metal-to-metal.

Drop-forged alloy-steel connecting rods are interchangeable between engine and compressor cylinders. Crankpin ends have centrifugally babbitted, removable bearing shells, shim adjusted. Crosshead and wristpin ends are of solid type, with bronze bushings.

Crankshaft, Bearings. Heat-treated forged one-piece crankshaft rides in horizontally split babbitt-lined bearings. All main bearing shells are interchangeable except scavenging-pump end bearing. Thrust is carried by flanges of second bearing from flywheel end.

Scavenging Cylinders. The 1600-hp unit at Monroe has two scavenging-pump cylinders (see photo and cross-section). Scavenging air goes to manifolds on either side of the engine, with connections to a belt surrounding the intake-port openings. Air then flows straight through the cylinder to the exhaust valves and out into a water-cooled exhaust manifold.

Main, connecting-rod, camshaft and wristpin bearings, and valve gear are pressure lubricated from a positive-drive gear pump. Engine and compressor cylinders and compressor stuffing boxes are oiled by a forced-feed lubricator, driven from the camshaft.

Ignition System. A low-tension magneto distributes current to high-tension coils on each cylinder head, adjacent to spark plugs. This keeps high-tension wires short. Low-tension wires run in a single conduit. Magneto mounts on forward end of main frame and is driven through bevel gears from the camshaft.

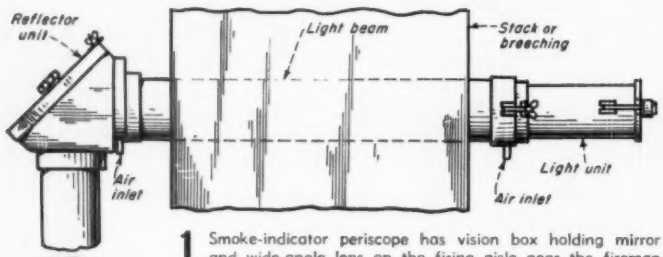
Fuel System. Fuel gas is supplied to the engine at 40 to 60 psi, depending

(*Continued on page 188*)

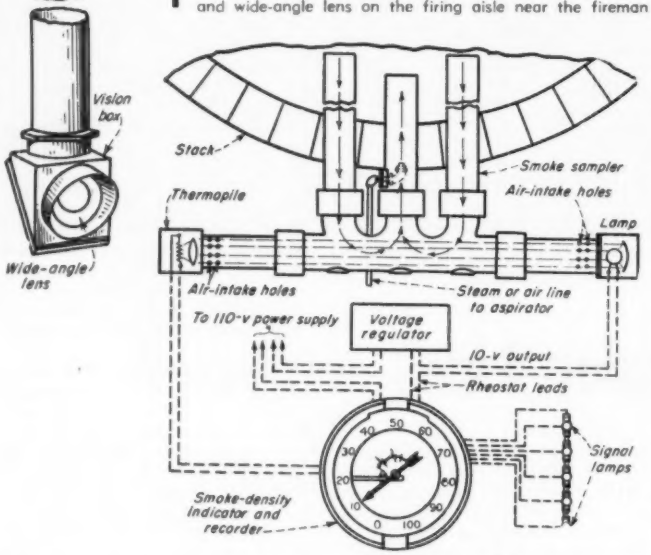
ELECTRONICS FOR THE POWER ENGINEER

By F A ANNETT, *Associate Editor*

Two Designs of Smoke Indicators



1 Smoke-indicator periscope has vision box holding mirror and wide-angle lens on the firing aisle near the fireman



2 Diagram of thermal design of smoke-density sampling, indicating and recording system that uses a thermopile to measure the radiation from the light source

24—Smoke Indicators, Recorders

► STACK-GAS DENSITY is a serious problem in every boiler plant. Of first importance is the direct relation between smoke density and combustion efficiency. Thus, dense smoke shows it is insufficient air that is making combustion incomplete, while very light flue-gas density indicates that too much air is being admitted to the furnace for best combustion. Either condition results in loss of both boiler and furnace efficiency.

Smoke a Nuisance. Dense smoke is a nuisance to the community where the offending plant is located. It is prohibited by law in many localities. Even when not restricted by ordinances, smoke may cause plant management the loss of community goodwill or costly court actions for damage by soot discharged from stacks. Installation of proper fuel-burning equipment and correct firing procedure can eliminate this nuisance, but a means of observing stack-gas density is required.

Density Measurement. Smoke density is determined in several ways. Because of this problem's importance to power-plant operating engineers all methods of smoke-density indicating and recording will be considered here and in future articles. Some of these systems use means for direct observation; others measure density by thermal devices for operation of indicating and recording meters; several use electronic devices.

One of these devices uses a portable smoke-density gage, which consists of a sampling tube to go into the breeching or stack, an aspirator and a sampling paper holder—all connected with rubber tubing. Usually this tester is used in combination with a CO_2 indicator to determine stack-gas density at high combustion efficiency.

To make a smoke-density test a piece of sampling paper is inserted in the holder, the end of the sampling tube put through an opening in the breeching or stack. A smoke sample is then forced through the paper by 20 strokes of the aspirator bulb. The sampling paper is removed and the density or darkness of the smoke is compared with a chart.

This device gives the smoke density only when making the test, which is satisfactory for certain purposes. But the boiler operator needs a means that permits him to observe stack-gas density at any time.

Mirror Reflects Smoke. One of the earliest means for observing flue-gas density placed a mirror outside the fire room in such a position that the fireman could see in it the top of the stack from the firing aisle. This simple device permitted him to see the stack top without going outdoors, but it had several faults.

Smoke, started in the furnace, had to travel several hundred feet, depending on plant size and stack height, before it could be seen and something done to eliminate it. The mirror might be several hundred feet from the stack top, a condition not favorable for close observation by the fireman. Often the mirror could not be placed where he could conveniently observe the stack.

Periscope Indicator. From this crude start came the modern periscope design

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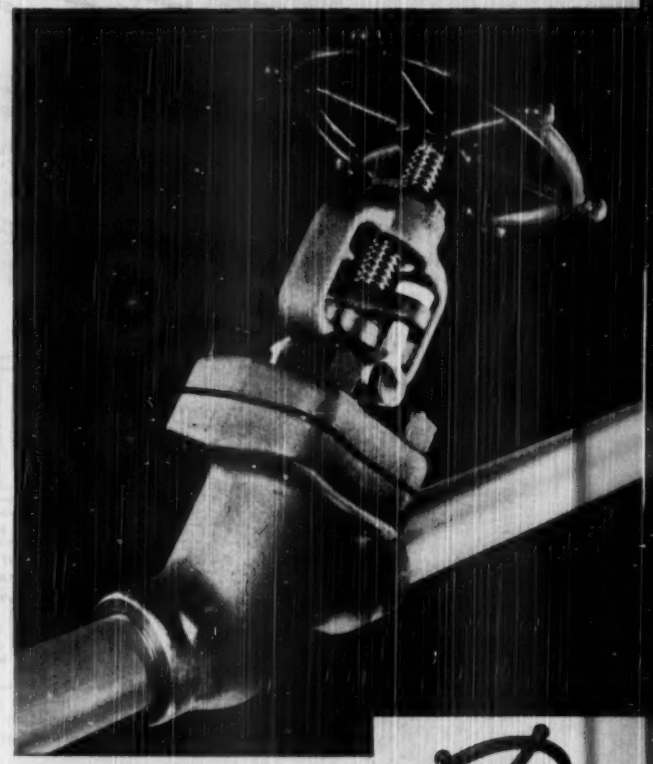


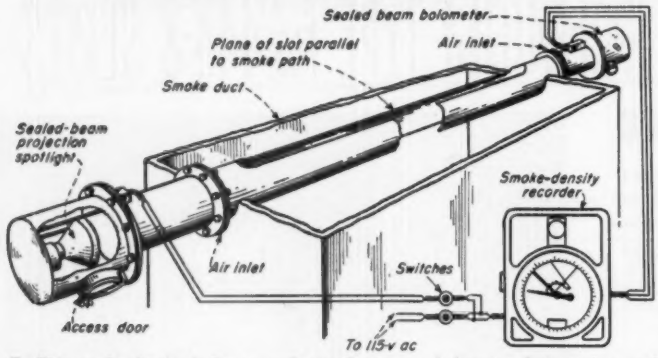
MAINTENANCE MAN'S DREAM

Gland bolts swivel out of way but can't come off. Gland rests on yoke. Plenty of room between stem and yoke. Both hands free for repacking.

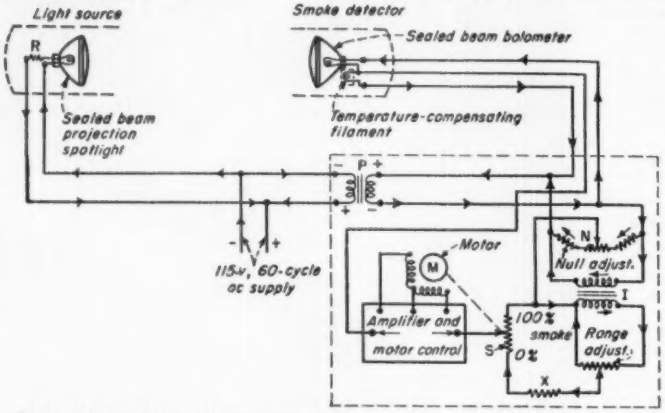
BONNET ASSEMBLY HAS EVERYTHING

Built-in pressure-tight backseat. Bronze yoke bushing. External threads EValized against corrosion. EValloy stainless steel stems, EValloy or Stellite seats and disks. Easy-grip non-skid handwheels.

Bolometer Smoke-Density Recorder



3 This smoke-density indicator and recorder uses a bolometer that receives and measures the radiation from a light source on one side of the boiler breeching



4 Simplified diagram of the measuring circuits for the smoke-density indicator and recorder, Fig. 3, which operates on the accurate null-balance principle

of visual smoke indicator. Fig. 1 shows essential parts of one design that includes a light unit mounted on a pipe nipple about one foot from the breeching side. A lens focuses light into a beam across the breeching to a reflector unit. Air flowing in front of the lens and into the breeching prevents dirt in the flue gas from fouling the lens.

A pipe nipple welded to the breeching supports the reflector unit directly opposite the light. In this unit a glass window closes the opening into the breeching. Air flows in back of the window and into the gas stream to keep the glass clean. Set at 45 deg to the window, a mirror turns the light beam 90 deg through a pipe to the vision box Mounted on a ball socket joint in the reflector unit, the mirror may be adjusted to compensate for errors when mounting the light and reflector.

Vision box, which is on the firing aisle where the fireman can observe smoke density most conveniently, contains mirror and wide-angle lens. Light beam from the reflector unit strikes the mirror, and is turned at right angles into the lens where he can see its color.

This lens is specially made for easy smoke observation and interpretation. Frosted on its outer portions and clear in its center, smoke can be observed in the lens at an angle of 45 deg, either side of its center. Heavy smoke is easily seen in the clear portion of the wide-angle lens. Finer hazes, difficult to see and evaluate in bright light, are clearly seen in the frosted portion for easy interpretation.

Smoke Observation. This equipment permits observing flue gas as soon as it leaves the boiler without having to wait till it leaves the stack top. Such installation transmits smoke-density indications up to 100 ft and around several 90-deg bends along the ways. But it becomes expensive because of the amount of 4-in. pipe for connections and the number of reflector units.

For small and medium-size boilers in industrial plants and on board ship, the visual indicator is comparatively inexpensive, easy to install and maintain. About the only maintenance is occasional cleaning of lenses and other parts.

By close observation of the vision box, particularly when firing rates change, the fireman can keep an accurate check on smoke density. But this depends on his diligence and ability to interpret what the indicator shows, particularly in the finer hazes. In other words, the human element is one of the chief factors.

Other Indicator Designs. To eliminate the human element in smoke-density interpretations, two general equipment designs have been developed: (1) Units operate on thermal principle. (2) Units use phototube to observe smoke.

These equipments sample smoke automatically in the breeching or stack base, measure its density, and continuously transmit the results to the firing aisle so the operator sees them immediately. The devices can be provided with indicating or recording instruments showing amount that flue-gas density is off color, and with visible and audible signal to call attention to poor operating conditions.

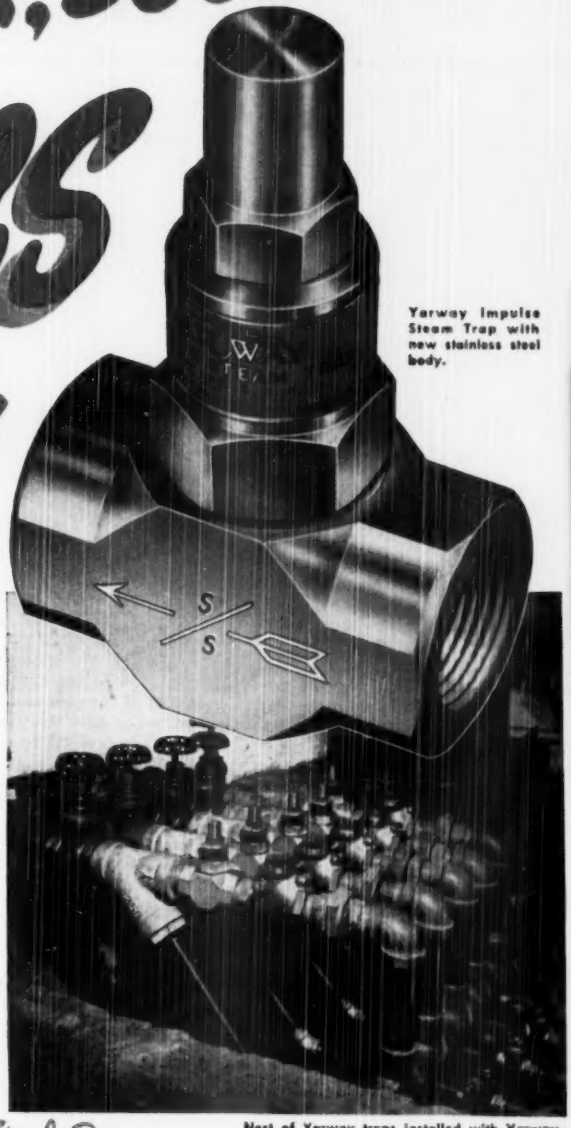
If a recorder is installed it provides a permanent record to show how carefully the fireman does his job, and also for future reference if any question arises about smoke from the stack. Developed as smoke indicators, these instruments now have a range and sensitivity to detect in the stack gas fine differences in haze that indicate small changes in combustion efficiency. They are now more correctly called haze or combustion-efficiency meters.

Thermopile Measures Smoke. Fig. 2 diagrams a thermal smoke-density sampling system with its indicator and recorder. Sampler consists of three tubes extending into the side of the stack or breeching. A steam or air aspirator in the center tube draws gas samples in through the two sampling tubes to a measuring chamber. These samples are mixed in this chamber, and from there they are discharged to the stack through the aspirator tube. Sampler tubes extend far enough into the gas stream to obtain a representative sample. By drawing gas from two points and mixing them in the measuring chamber, effects of stratification are reduced.

Light of a voltage-controlled lamp at

(*Continued on page* 158)

"HOTTER, SOONER" SAVES YOU MONEY



Yarway Impulse Steam Trap with new stainless steel body.

Yarway Impulse Steam Traps get equipment hot and into production *faster.* Extra profits!

Then they keep it *continuously* at peak operating temperatures for maximum production. More extra profits!

What's the reason for *hotter, sooner?* Just this. When steam is turned on, Yarways open wide, discharging the air and condensate *in a hurry* —closing only when steam arrives. Then, when operating temperature has been quickly reached, the little valve (only moving part) literally *floats on the load* . . . discharging heat-retarding condensate as soon as it forms instead of waiting for quantities to accumulate. Thus equipment is held at peak operating efficiency.

Other economical features of Yarway traps—minimum maintenance, easy installation, low initial cost.

More than 600,000 Yarways have already been installed. Sold by distributors throughout the world.

Try a Yarway today . . . standardize on Yarways tomorrow.

YARNALL-WARING COMPANY
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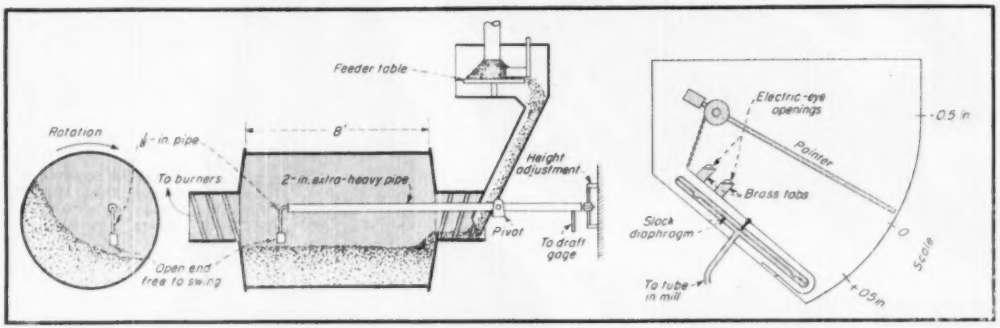
Nest of Yarway traps installed with Yarway Strainers on cloth dryer. Note small space required.

Stainless Steel Body

YARWAY IMPULSE STEAM TRAP

POWER ENGINEERS' NOTEBOOK

PLANT-TESTED IDEAS TO SOLVE PROBLEMS OF DESIGN, OPERATION AND MAINTENANCE



AIR-PRESSURE MEASUREMENT CONTROLS COAL-MILL LEVEL

We had considerable trouble with the electronic-level controls on our ball-tube mills serving our boilers. Maintenance ran rather high. In addition, the detecting elements were too close to the mill inlet. Whenever the coal was wet, level at the inlet tended to drop away from the detecting element. This called for more coal, which would flow out of the mill onto the floor and also plug up the mill fan. This difficulty caused shutdown several times so we designed the level control shown in the sketch above.

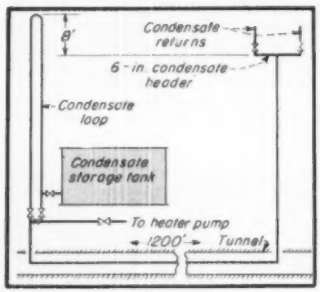
We placed a ⅛-in. pipe to extend about 6 ft into the mill. Inner outlet carried a 1¼-in. pipe as shown. This run is protected by the 2-in. extra-heavy pipe. Other end of the pipe connects to a draft gage, shown at right in the sketch. Gage range runs from −0.5 to +0.5 in. water. At high burning rates the mill pressure runs about −0.2 in. water. End of the pipe in the mill can be adjusted to hold whatever level is chosen by means of the setscrew at the outer end.

When the coal level builds up, it covers the open end of the pipe and the gage reading rises to 0 in. On the draft gage are two photoelectric cells scanning two light sources on the opposite side of the casing. Two brass tabs soldered on the draft-gage arm pass between the light sources and the cells. They are set so that, when draft-gage reading reaches −0.05 in., one tab blocks the view of one photocell, which through a relay cuts the feeder-table speed to half. At 0.0-in. draft-gage reading, both photo cells are blocked and a relay stops the feeder table preventing any coal overflow.

This arrangement controls the mill level to less than ¼-in. range, automatically under any load and moisture content of coal. These controls have been in service at our industrial plant for over a year with completely satisfactory results.

C Werderitch *Albert Lea, Minn.*

CONDENSATE LOOP CORRECTS ERRATIC PUMP OPERATION

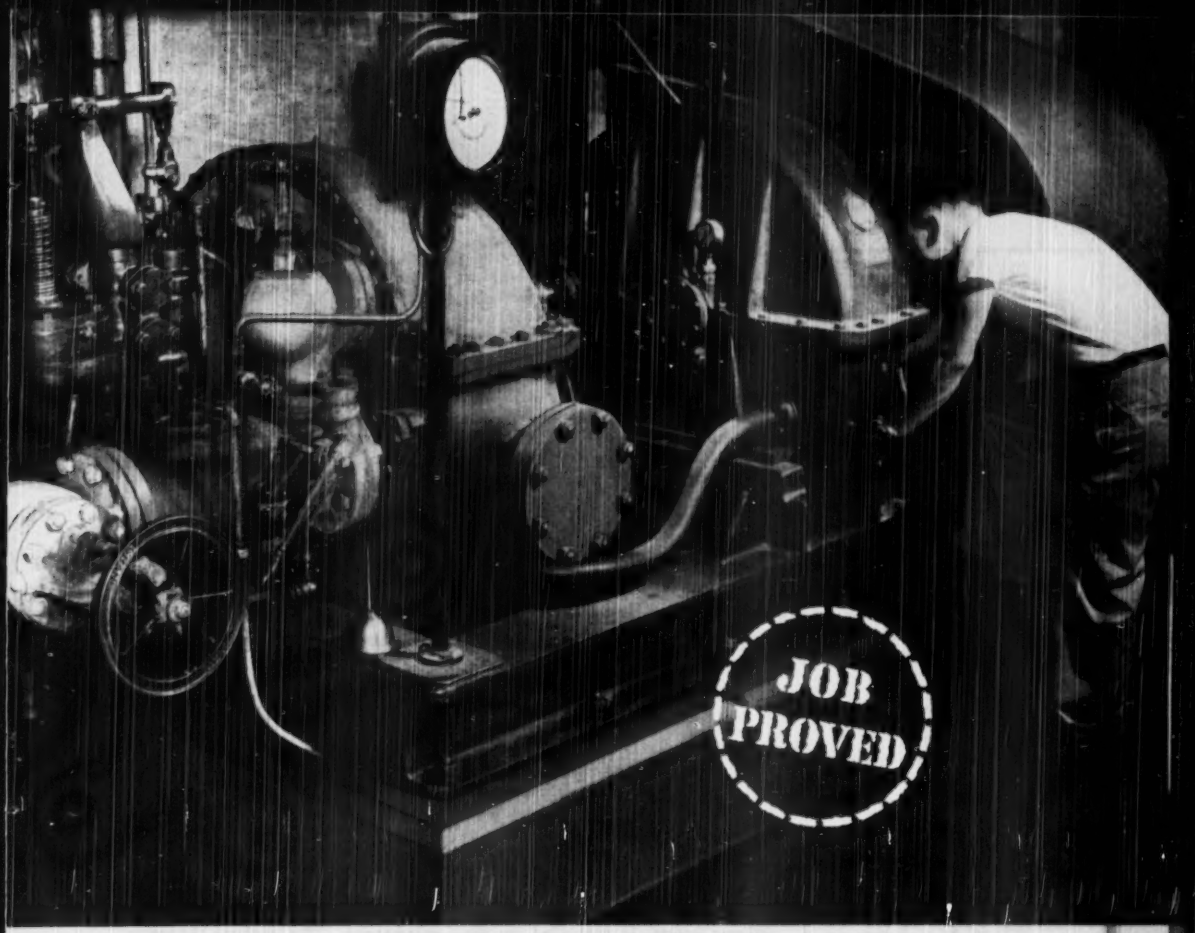


We have 24 pumps pushing condensate from process and heating units back to the boiler room through a 6-in. main. This 1200-ft main runs underground through a tunnel, terminating in a 2000-gal storage tank. Tank overflow is 4 feet below ground level. When none of the pumps were running the main would drain down to the overflow level. Subsequent starting of any condensate pump would compress air in the main, causing considerable vibration and noise and very erratic pump operation.

We corrected this condition by installing a condensate loop at the tank, as shown in left side of the sketch. Peak of the loop was made 8 feet higher than the factory main. Valves at the loop and tank enable us to operate the loop when the tank is out of service. The loop creates a discharge head for the pumps to work against and keeps the condensate main full of water at all times.

A Rocklin *Chicago, Ill.*

(*Continued on page* 132)



SUNVIS 900 OILS REDUCE COSTS 25%

Papermaker Gets Maximum Equipment Protection, Extra Long Service, from Superior Turbine Lubricants

In a large paper mill, eight steam turbines drive paper machines and pumps, and generate power for ventilating equipment. Ten years ago the mill began lubricating these turbines with a "Job Proved" Sun oil. They gave unfailing service with remarkably low oil and maintenance costs.

Four years ago, when Sunvis "900" Oils first became available, the Sun representative serving the mill saw an opportunity to effect even greater economy. He suggested that the medium-priced Sun oils in use be replaced by the more costly Sunvis "900" Oils. He knew that these modern, fortified lubricants—*more costly* on a per-gallon basis—would prove *less costly* through the years because of their remarkably long life. His suggestion was followed.

The Sunvis "900" Oils have fully justified this confidence, saving the mill 25% or more on lubrication costs. Furthermore, the papermaker knows his equipment—running or idle—is fully protected from rust and corrosion.

Sunvis "900" Oils are *good for the life of your production equipment*. Coupled with the know-how of the Sun representative who calls on you, they are good for your pocketbook, too. For more information, send for a copy of the illustrated booklet "Sunvis '900' Oils". Write Department P-4.

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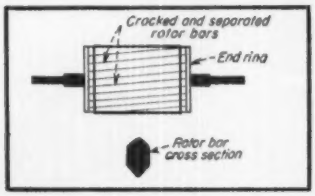
SUNOCO

COPPER-ROD REPLACEMENT PUTS MOTOR BACK IN SERVICE



WE EXPERIENCED TROUBLE with a vertical 12.5- to 25-hp, 600- to 1200-rpm, squirrel-cage, constant-torque motor driving a centrifugal extractor. It was taking a longer time to gain full low speed from standstill and also to accelerate from low to high speed. Checks on frequency and voltage showed them to be all right. Current flow, however, showed a decided drop from normal values. The higher resistance could be caused by either or both (1) breaking of rotor bars (2) unwelding of rotor end rings. Upon dismantling the motor we found the first item was causing the trouble.

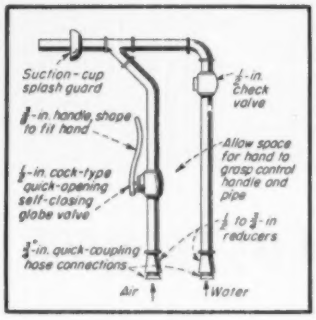
More than half the rotor bars were cracked and had separated by 1/16 to 1/8 in. in the core slots. We needed the motor badly and it would take a long time to get a new one. So we had to put this one back in service quickly, in 24 hours, in fact.

We unbrazed the end rings and removed all the copper bars. Sketch shows the cross sections of these bars. We couldn't find any replacements. As a substitute we bought some round copper rod of equivalent cross-sectional area. Diameter of this rod was larger than the width of the original bars. Each rotor slot was drilled out to permit the proper drive fit of the replacement rods. After driving in the rods they were brazed to the end rings and the motor was reassembled.

Making a blocked-rotor test at reduced voltage showed the starting current to be normal. It might be thought that running a drill through the rotor slots would burr over the lamination edges and cause heating by eddy currents. Also, the new bars of unknown resistance might materially change the characteristics of the motor. Despite these possibilities the motor operated normally when restored to service, and continued so till eventually replaced.

G ELLIOT *Amherstburg, Ont.*

TOOL SPEEDS CONDENSER CLEANING WITH COMPRESSED AIR AND WATER


Suction-cup splash guard
¾-in. handle, shape to fit hand
½-in. cock-type quick-opening self-closing globe valve
¾-in. quick-coupling hose connections
¼-in. check valve
Allow space for hand to grasp control handle and pipe
¼ to ¾-in reducers
Air
Water

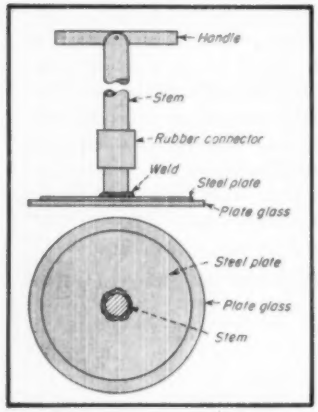
IN OUR MAIN CONDENSERS we have found that compressed air pushing along slugs of water does an excellent tube-cleaning job. A fairly large volume of 100-psig air is needed. The cleaning tool, made up of ½-in. pipe and two valves shown in the sketch, makes this method very easy. Air flow from a 100-psig source is controlled by the quick-opening self-closing globe valve. Water may be supplied at any convenient pressure through the second line.

Operate this "gun" by shooting short bursts of air into the tube. This picks up water that flows through the check valve and sends it scurrying through the tube with good scrubbing action. Each time the air valve opens, the water check valve closes, preventing air backing up into the water line. One or two bursts usually clean a tube.

Working end of the gun is pushed into the tube to be cleaned, up to the splashguard. This confines the water in the tube and prevents the operator being hit by high-velocity water drops. Proportion the gun to suit your individual conditions, making sure it can be carried through manholes.

A W SHEPHERD *San Diego, Calif.*

PLATE-GLASS TOOL GRINDS GATE-VALVE SEATS



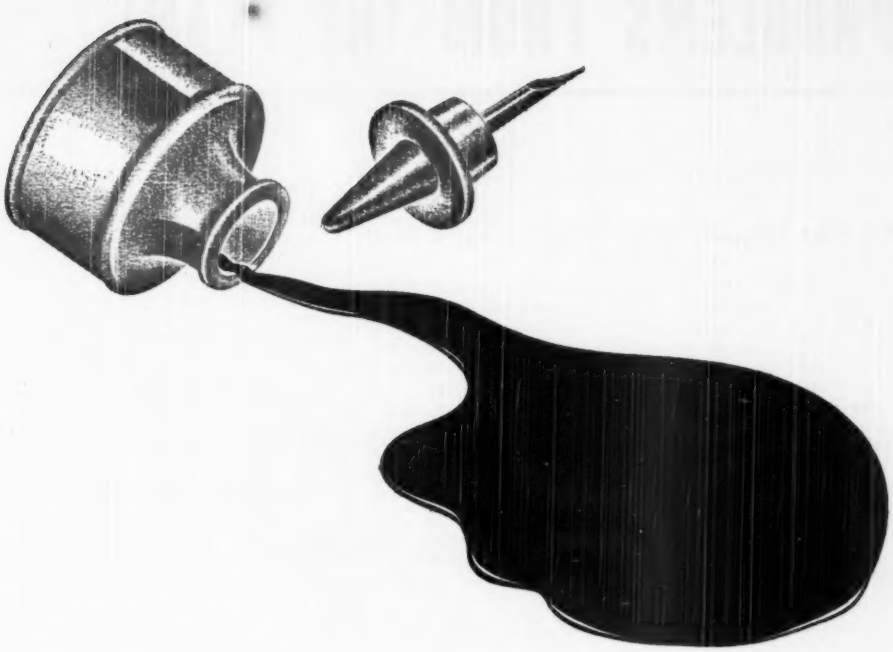
WE HAD TO GRIND IN a 10-in. gate valve without having tools to remove the ring seats. Our maintenance crew decided to try plate glass. We found this did a first-class repair job at very little expense. With a little practice we quickly acquired the skill needed to do an excellent job.

We took down the valve and disassembled it. We ground the wedge on the work bench with a piece of plate glass and grinding compound. Grinding was made to progress evenly all around.

We then made the tool in the sketch to grind the ring seats in place. We cut a round piece of plate glass, larger than the ring seats but small enough to enter the valve body. On a flat iron plate of slightly smaller diameter than the glass plate we welded a 2-in. length of iron pipe. This assembly was glued on the plate glass disk, as shown in the sketch at left, with a suitable adhesive.

The glass with its support was then put in place against the ring seat by moving it in through the opposite flange opening. The iron pipe connected to a handle through a short piece of rubber hose. In this manner the glass could be maneuvered to grind the seats and make a tight valve.

J A SWANSON *Princeton, B. C.*



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And, it's a most important "product" for *your* business—black ink for your ledger! As a nationwide service organization of engineers and chemists specializing in the solution of all water problems, we offer a complete water conditioning service that is scientifically correct—designed to help you cut plant operating costs. If the results you are presently obtaining are not entirely satisfactory, let us explain more fully how our specialized service can benefit you.

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PROBLEMS FROM THE PLANT

THIS MONTH'S QUESTION

Can I Correct Dripping From Cold-Storage Coils?

I HAVE A COLD-STORAGE produce room about 5x50 ft. Ceiling coils are 16 ft from the floor. I try to keep a temperature of 34 F. Room is piped with 1800 ft of 2-in. direct-expansion ammonia piping, arranged in two flat coils and supported from ceiling joists.

Load varies considerably at times as, for instance, when warm produce is moved in, doors opened, etc. Two manually operated expansion valves control the ammonia system. We are having trouble maintaining a constant frost line on the evaporating coils. When room temperature goes up a few degrees the coils start dripping, damaging containers.

Will any reader suggest a method of improving operation without resorting to water pans under the coils to carry off the drip?—*WH*

Exercise your engineering wits by submitting answers to this question fresh from the plant. Suitable material will be paid for; answers accompanied by sketches or photographs command additional pay

READERS ANSWER THE JANUARY QUESTION...

What Causes Vacuum Drop?

(This question is from January issue with the best answers from readers.)

We have a tough vacuum problem on one of our steam turbines, designed for 225-psi steam. We operate at 250 psi, superheated to 560 F. Turbine discharges direct to a condenser having 13,725 sq ft of surface.

Circulating pump in condenser circuit handles 14,000 gpm and is powered by a 200-hp motor. On the electrical side, the 10,000-kw 3-phase generator runs at 1800 rpm and feeds into the 11-kv 60-cycle station bus. A double-stage air-jet pump removes air. Average barometric plant pressure is about 25.5 in. Hg.

And now the problem. We notice a big drop in vacuum when electrical load reaches 5000-8000 kw. At the latter load, vacuum drops to 12 in.

Our first checking point was the vacuum pump. We have tested this separately, along with hydrostatic tests on condenser, and all seems OK. With generator running at no load, vacuum is about 24.5 in. At 3000-kw load, vacuum drops to about 23 in. As load increases we notice a progressive drop till 12 in. is reached at 8000 kw. Perhaps POWER *readers can tell us why.—LM*

May Be Condensate Pump

CONDENSER SIZE and circulating-water quantity seems adequate. First thing to check is circulating-water inlet and outlet temperatures. Sometimes you can pull heated water into your suction line from your neighbor's discharge.

Quick test for a bad air leak is to check the steam space temperature against the saturation temperature corresponding to that steam pressure. A lower steam-space temperature indicates presence of noncondensable gases.

If both the above tests check out, it is a good guess that condensation is backing up in *LM's* condenser hotwell and filling up lower part of condenser. Remember, all condensate pumps cavitate some of the time, and some condensate pumps cavitate all the time. Deterioration of pump performance is quite rapid in this service. Pump gradually requires more and more suction head, which it obtains by permitting condensate to pile up in lower section of condenser.

A check on the pump can be made as follows: Rig an accurate vacuum gage on suction side of condensate pump. Comparison of readings from this gage with simultaneous readings of the condenser vacuum gage give a rough measure of pump suction head. Take readings both at light load with good vacuum and at heavy load with the poor vacuum. If the difference in pump suction head is enough to flood the condenser, you can be sure the pump is not doing its job.

Pull out that pump's insides and have a look. Chances are you will find a badly eroded first-stage rotor. If it is an old design, try to get an erosion-resisting alloy for your new rotor.

W TAMLYN, JR

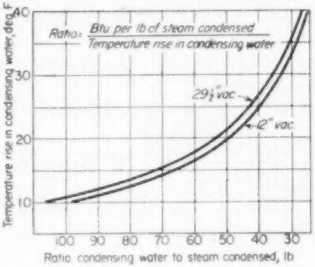
Queens Village, N. Y.

Condenser Size OK

CONDENSER TROUBLE is often caused by air leaks into the system. A small leak in the vacuum-gage piping, where it connects to turbine exhaust, caused a low reading in our plant until it was discovered and corrected. This cause can be checked by raising the vacuum and shutting off gage line at exhaust pipe. If all is tight, mercury reading should remain steady for a long period.

A small quantity of air at atmospheric pressure becomes a sizable volume at a vacuum of 24 in. Hg. It may overload the air-removing apparatus or blanket a section of tube surface if a pocket is formed.

Ratio of condensing water to steam condensed may be found by this formula: Ratio equals latent heat of steam at given vacuum ÷ deg-F rise in condensing-water temperature. Accompanying curves show ratio for various


Ratio = Btu per lb of steam condensed / Temperature rise in condensing water
29½" vac.
12" vac.
Temperature rise in condensing water, deg F
40
30
20
10
100 90 80 70 60 50 40 30
Ratio condensing water to steam condensed, lb

values of temperature rise in condensing water between 10 and 40 deg.

LM's pump rating of 14,000 gpm is equivalent to 116,700 lb per min, or 7,002,000 lb per hr. Assuming a steam consumption of 120,000 lb per

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hr, ratio of condensing water to steam is only 58.3 lb, which is ratio corresponding to a rise of about 18 deg. Thermometer readings on inlet and outlet waterboxes indicate temperature rise. If rise is excessive it indicates lack of sufficient water or fouled tubes.

C B Hudson *Plymouth, Mass.*

Similar Case Solved

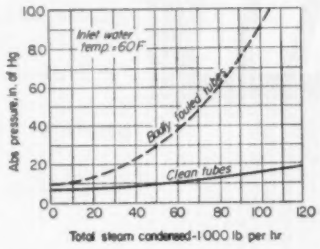
We had exactly the same experience with a condensing unit, and examined every piece of equipment including the shaft seals. We filled the brute with water but found no leaks. Removed the condenser heads and looked through the tubes; they shined like gun barrels. But still low vacuum.

Finally we removed about six tubes from different sections, cut them into short pieces and found them coated on inside with 1/32 to 3/64 in. of hard scale. That was the answer to our problem.

We rigged up a small centrifugal pump and tank, and circulated a solution of inhibited hydrochloric acid and warm water (15% acid and 85% water). As the solution weakened we added acid. After the acid treatment, we circulated fresh water through the condenser, and started the unit with good results.

Our unit has a cooling system tower, and certain precautions and water treatment must be used. If *LM* wishes to contact us, we shall be glad to assist him in any way possible.

C Demere *Memphis, Tenn.*



Air at Piping High Spot

Vacuum maintained by a condenser depends on (1) removal of air and (2) quantity of heat transferred from steam to cooling water.

Any trouble with air accumulation, caused by leaky low-pressure seal on turbine or defective air pump, would be noticed at no load as well as at partial and rated loads. So trouble is from insufficient heat transfer from exhaust steam to cooling water. If heat transfer is low because of tube fouling or reduced flow of cooling water, characteristic curve of condenser at any given inlet temperature is affected, as in sketch above.

Installing thermometers and pressure gages at strategic points quickly determines whether the vacuum is going down because of reduced water flow, tube fouling, or a combination of both. Gages and thermometers, at waterbox inlet and outlet, and pressure connect at circulating-water pump suction and discharge.

Air getting into water side of condenser is fully as effective in reducing vacuum as it is on the steam side. In conventional siphon circulating-water system, the high spot is usually the water outlet at condenser. Suction line from a priming ejector should be connected at this point to purge system of air at start-up and keep it purged during operation.

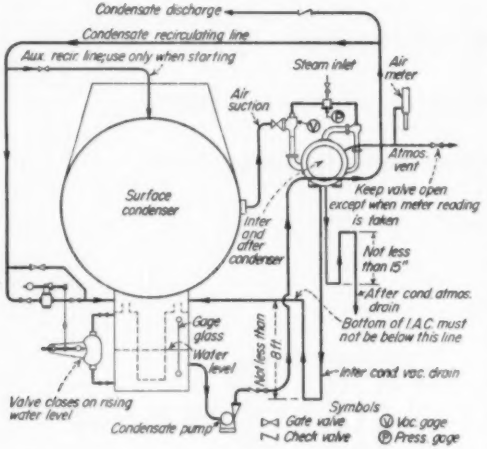
F G Jones Jr *Philadelphia, Pa.*

Inter-Condenser at Fault?

In a 2-stage steam-jet ejector, each stage is designed to operate over a definite pressure range. When a 2-stage unit is operating at 12 in. Hg, first stage is doing essentially no work. Under this condition it is best to shut off the first stage, and operate on the last stage alone. This helps matters although it is not the complete solution.

Since the ejector is able to maintain 1 in. Hg absolute pressure with no load on generator, it is of sufficient

(*Continued on page* 172)



Hotwell Control Scheme

First, clean tubes and waterboxes thoroughly. I assume condenser shell is tight, and ejector performance OK. Then determine steam flow, absolute condensing pressure and circulating-water temperature. Friction loss of water through condenser is a good cross check against rated 14,000-gpm flow if we know number of tubes, outside diameter, gage and number of passes. These, with temperature rise of water, give a good steam-flow check. Then, air temperature to air ejector gives a clue to efficiency of air-cooler zone.

From above data, we can determine water velocity through tubes. This, in turn, determines heat-transfer coefficient theoretically obtainable with clean tubes. Assuming tubes are ⅞ in. OD, over-all heat-transfer coefficient for *K* flow should be about 263 times square root of water velocity.

If this condenser's tubes are 20 ft long, arranged in two passes with total of 3000, velocity is about 6.3 fps. Assuming condensing-water rate of 12 lb per kw, and water temperature at 90 F, I would expect outlet water of about 95 F. Under these conditions condenser should produce absolute pressure of about 1.75 in. Hg abs at 3000-kw load point. The 2.5-in. pressure given indicates dirty tubes or a fundamental condenser defect, like a corroded air baffle.

Checking operation at 8000-kw load point, even with 90-F water, I anticipate steam temperature about 108 F, or less than 2½ in. abs, compared to reported 11.5 in. abs.

Hence our assumptions are totally incorrect, or something is radically wrong with the condenser. If a large number of tubes were plugged, it would show up in an excessive pressure drop. Sketch to left is a suggested arrangement for hotwell control that will eliminate condensate backing up into tube area, along with other advantages.

H G Johnson *Philadelphia, Pa.*

No. 3

Quick Quiz on Copper Piping

Q **Isn't copper tubing more expensive to use than piping made of other materials?**

A In some cases, yes. In most cases, no. There are many conditions under which ANACONDA Copper Tubes prove to be the *least* costly piping obtainable. Prevention of rust, corrosion and contamination, together with the lower labor costs of installing solder-type fittings, often more than offset differences in piping material cost.

Q **Why is copper tube easier to install?**

A There are many reasons. First, ANACONDA Copper Tube is light, easy to handle. Second, it comes in longer lengths, which saves cutting and fitting. Third, it is more flexible, can be bent on the job—again saving cutting and fitting. Fourth, required connections are fast and easy to make. No threading.

Q **Are changes in piping systems easier to make where copper tubing is used?**

A Decidedly so, in very many cases. As you know, a badly rusted threaded pipe joint is sometimes almost impossible to uncouple without breaking the pipe or coupling. With ANACONDA Copper Tubes no such difficulty occurs.

Q **Where can I get more facts?**

A A well illustrated booklet, "ANACONDA Copper Tubes for Industrial Applications," can be had on request. It contains a wide range of information on copper tubes, their applications, advantages and installation. Numerous reference tables useful to user and installer are also included. For a copy of this booklet, ask for Publication C-24 and send your request to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

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COPPER TUBES

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ENGINEERING DEVELOPMENT HERE AND ABROAD DIGESTED FOR BUSY POWER MEN

REVIEWED IN THIS ISSUE

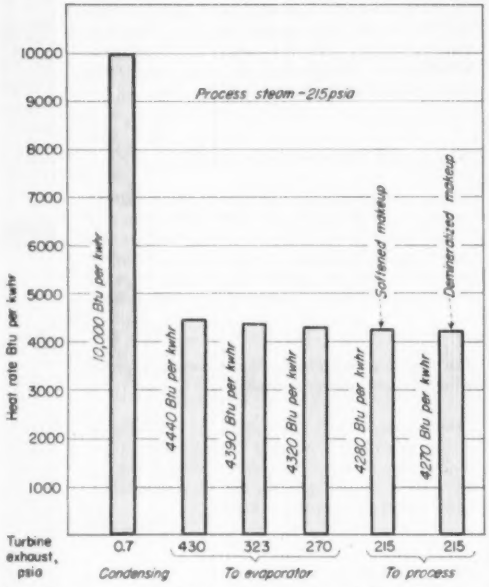
WATER TREATMENT: Chemical Treatment, Demineralization or Evaporation for Makeup in High-Pressure Steam Plants • Oil-Refinery Waste Treatment

COMPRESSORS: Investigations of Axial-Flow Compressors • Centrifugal and Axial-Flow Compressor Hydraulic Performance

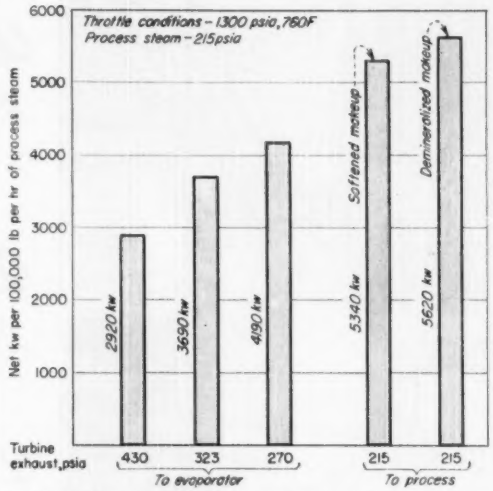
GAS TURBINE: A 4500-Hp Gas-Turbine Electric Locomotive

ELECTRICITY: Control of Large Dc Motors Supplied From Ignitron Rectifiers • Rectifier Equipment for Electronic Dc Motor Drives • Bus Transfer Tests on 2300-V Station Auxiliary Systems • Audible Noise of Power Transformers

Directions for ordering papers are given on page 140



1 Heat rate in Btu per kwhr compared for condensing plants, and byproduct plants exhausting to evaporators, process



2 Advantages of exhausting turbines in a byproduct power plant direct to process results in a low-fuel-cost power

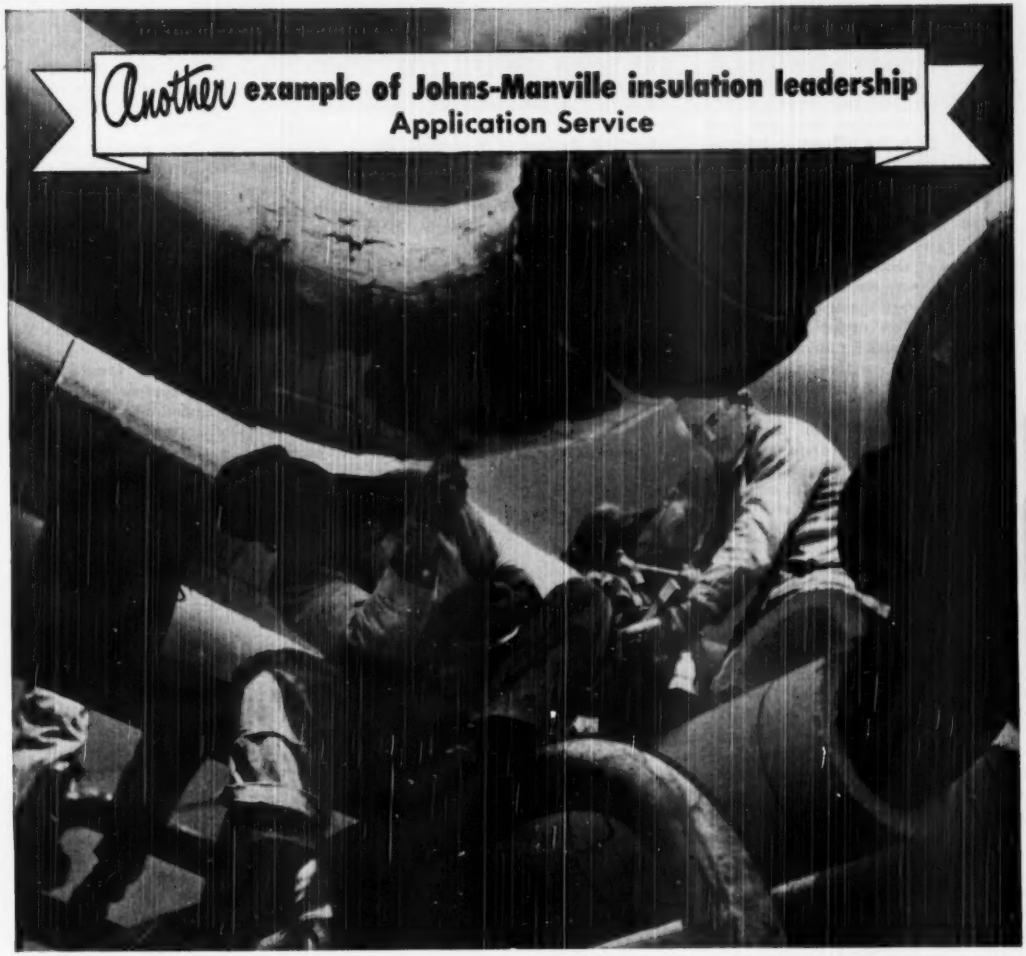
Water Treatment

CHEMICAL TREATMENT, DEMINERALIZATION OR EVAPORATION FOR MAKEUP IN HIGH-PRESSURE BYPRODUCT STEAM PLANTS, *by J D Yoder, vice-president, The Permutit Co, W L Webb, mechanical engineering div, American Gas and Electric Service Corp, and T Baumeister, mechanical engineering div, of the same company.* Power manufactured as a byproduct of process steam offers lowest cost for fuel per kilowatt-hour obtainable from any type power plant. The most efficient high-pressure power plant that is devoid of the byproduct feature and delivers only one product—kilowatt-hours as electrical energy—still wastes, as low-grade heat in cooling water of the condenser system, about 50% of the heat supplied in fuel. Lowest heat rate as yet anticipated for a central station is 9300 Btu per net kwhr for Philip Sporn Station.

Increased power production is demonstrated. It is obtained by exhausting high-pressure turbines direct to process rather than to coils of evaporators, which in turn produce process steam. Typical heat balances are presented for systems employing evaporated makeup to the closed cycle and for 100% makeup cycles using water treatments consisting of (1) silica removal and sodium-zeolite softening, (2) demineralization and silica absorption. The performance data and costs are given for both evaporated makeup and 100% treated makeup, 1400-psi cycles at Deepwater Operating Co's station. *ASME paper No. 49-A-71.*

OIL REFINERY WASTE TREATMENT, *by E M Proctor, Redfern & Laughlin, Toronto, Ont., Canada.* Treatment of industrial wastes is receiving a great deal of study, and it is becoming increasingly evident that to handle them satisfactorily they must be studied as individual components of the final discharge. To treat a mixture of wastes is often difficult. This problem is sometimes caused by a small flow of a certain waste which, when treated individually, makes it possible to get excellent over-all results.

This is particularly true of refinery



Bright future... for this insulation investment

Each day many men in industry ask themselves this question—*Just how should I go about getting the most out of each insulation dollar?* The answer, as with any investment, depends on several factors.

First, there's the reputation of the insulation manufacturer; the type of materials he has to offer; the efficiency of those materials in saving fuel. Next, there is the kind of service the manufacturer offers for engineering and applying his insulations.

This last consideration is a mighty important one. For, assuming all other things to be equal, it is the selection of the right insulation and the correct application of it that pays off in the long run on your insulation investment.

...And that's where Johns-Manville leadership in application service can be of utmost help to you. Your Johns-Manville Insulation Applicator selects the right materials for your specific job from the wide variety of J-M insulations that are available (for temperatures from minus 400F to 3000F above zero).

You will benefit by the long experience of your J-M Insulation Contract firm in all phases of insulation application . . . from engineering the job to the skill of his mechanics in applying the insulations.

If you have an insulation problem, write to the blue chip name for insulation investments—Johns-Manville, Box 290, New York 16, New York.

Johns-Manville *first in* **INSULATIONS**

wastes that contain oil emulsions. In the standard oil-separation tank, where oil is floated off, the emulsions flow through the separation tank, and upon an analysis of the effluent a high oil content is found. These emulsions, when highly diluted in the receiving lake or river, break up, and as a result oil floats to the surface.

The paper describes a method of handling emulsion wastes. Results in one plant show conclusively that the emulsions, when passed through the main separation tanks, without any treatment for breaking them down, have a decided effect on the oil content in the daily tests of the effluent. With the emulsion properly treated, final tests show an even content of oil in the effluent. Average oil content has been reduced from 42 to 5 ppm and the irregular results in 1945 have been eliminated. *ASME paper No. 49-A-78.*

Compressors

INVESTIGATIONS OF AXIAL-FLOW COMPRESSORS, *by J T Bowen, research assistant, R H Sabersky, instructor, and W D Rannie, assistant professor, California Institute of Technology.* An approximate theory of the general perfect fluid flow in axial turbomachines. Validity of the simplifying assumptions of the theory is justified by comparison with flow patterns measured in a large, low-speed axial-flow compressor. It is concluded that the theory is convenient to apply, and is sufficiently accurate for most engineering purposes. Performance data on blading designed for 2- and 3-dimensional flow show that the blade types have comparable efficiencies.

It is suggested that designers exploit the advantages of unconventional blade types. Flow regions where fluid viscosity is important are shown. Experimental studies of cascade losses in the compressor indicate these losses are greater than those measured in a cascade test tunnel. Measurements show rate of growth of the wall boundary layer need not be unusually great in an axial-flow compressor. *ASME paper No. 49-A-102.*

CENTRIFUGAL AND AXIAL-FLOW COMPRESSOR HYDRAULIC PERFORMANCE, *by A J Stepanoff, Cameron engrg. dept., Ingersoll-Rand Co.* Chart of blow-performance characteristics and design elements cover the whole field of centrifugal and axial-flow types. Although originally devised for centrifugal and axial-flow pumps, the chart is equally valid for gas blowers when extended to higher impeller-discharge angles. It is drawn for a meridional impeller inlet (radial or axial), but provision can easily be made to take care of prerotation in either direction.

A number of necessary definitions and deductions, not widely known, are briefly discussed. The author published a detailed treatment of the theoretical background and experimental evolution of the chart, as applied to centrifugal pumps, in *Centrifugal and Axial-Flow Pumps,* p 184; John Wiley, 1948. *ASME paper No. 49-A-88.*

TO OBTAIN COMPLETE TEXT

Material for these abstracts comes from one of the following sources:

American Society of Mechanical Engineers, annual meeting, New York, N. Y. Nov 28-Dec 1, 1949. Papers are identified by initials ASME. Obtainable through ASME, 29 W 39th St, New York 18.

American Institute of Electrical Engineers, winter general meeting, New York, N. Y. Jan 30-Feb 3, 1950. Papers are identified by initials AIEE. Obtainable through AIEE, 29 W 39th St, New York 18, N. Y.

Gas Turbine

A 4500-HP GAS-TURBINE ELECTRIC LOCOMOTIVE, *by A H Morey and R A Williamson, General Electric Co.* Advantages of gas-turbine locomotives are (1) high concentration of power in minimum space (2) ability to burn low-cost fuel (3) possibility of low maintenance with rotating apparatus. In comparison, disadvantages are (1) relatively high fuel rate (2) high rotative speeds needing reducing gears (3) capacity variation with altitude and ambient temperature.

Locomotive was designed to these specifications: (1) single-unit arrangement for freight service with possible conversion to passenger service (2) no idle axles (3) high weight per axle consistent with good maintenance and maximum tractive effort (4) clearances for widest possible use (5) cruising range comparable to diesel-electric units (6) electric drive (7) 4500-hp input to generator for traction (8) highest possible availability and lowest possible operating cost.

Expected life of 15,000 hr for critical parts practically fixed the inlet temperature and efficiency of turbine and compressor. Intercooling was considered impractical because all heat would have to be rejected to atmosphere. Study of regenerators showed air- and gas-pressure drops in the system together with probable fouling, which increases maintenance and produces a fire hazard. These reasons led to rejecting regenerator application.

Practical difficulties dictated using conventional-type air filters without oil on the filter surfaces. Only extended railroad service will show whether this is adequate, or may be more than needed. A silencer on compressor inlet does an effective job, but because of space limitations no silencer is provided on turbine exhaust. If the noise proves too high some silencing will be attempted.

In the locomotive now under test, power-plant starting approaches "push-button" conditions closely. The plant gets up to operating conditions in about three minutes provided fuel is at operating temperature. Standby heating equipment maintains its temperature.

Control permits full utilization of available power up to drive capacity. With continuing demand for higher speeds it is possible the present locomotive will find wide application. Change in fuel from heavy oil to coal would not affect design too seriously. *ASME paper No. 49-A-46.*

Electricity

CONTROL OF LARGE DC MOTORS SUPPLIED FROM IGNITRON RECTIFIERS, *by O W Livingston, General Electric Co.* Basic methods, in the control of large dc motors supplied from ignitron rectifiers, are discussed. To meet the requirements of most applications successfully, a control has to start the motor and accelerate it to the desired speed either in the armature or field-weakening range without distress or overload to the motor or connected load.

It must also maintain the required speed within accepted limits in spite of disturbing factors, such as supply voltage or load fluctuation. It must also decelerate or stop the motor without excessive overload or stress on the driven machines.

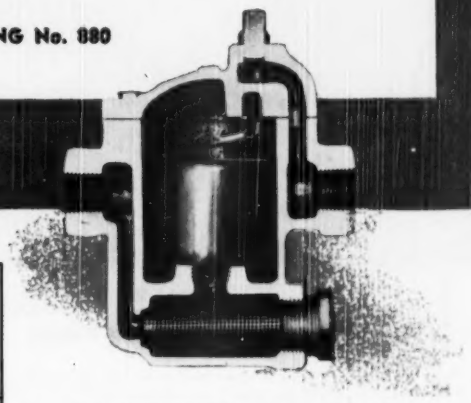
The author discusses three amplifier types used in such controls: (1) amplidyne amplifier (2) electronic amplifier and (3) amplistat, a magnetic amplifier. In his opinion, it is difficult to show that any one of the three systems is preferred for all control problems of this type. Each system has certain features that make it most desirable for a given application, and each has been successfully applied in actual installations.

At present, the vacuum-tube amplifier probably requires the lowest power input and gives the highest power gain per stage. But this is not the complete

(*Continued on page* 162)

"This little Trap is a time and money saver ... the strainer is built right in ..."

THE ARMSTRONG No. 880



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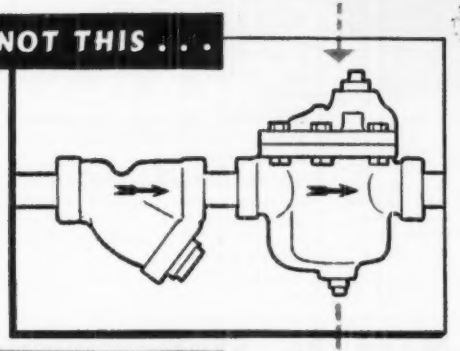

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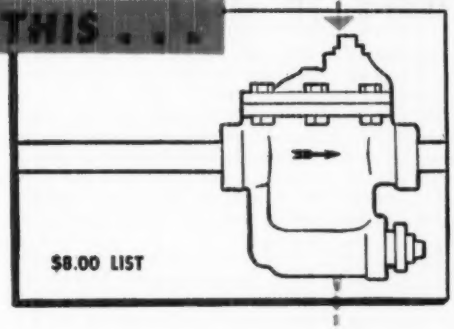

$8.00 LIST

AN ECONOMICAL steam trap for draining small equipment naturally has a small discharge orifice. When dirt or scale conditions are bad it is recommended that a strainer be installed ahead of such a trap to avoid clogging.

The Armstrong No. 880 trap is a perfect answer for such a condition. The strainer is built right into the body, thereby eliminating a separate strainer, extra fittings and considerable installation labor. Best of all, the No. 880 costs $1.00 to $1.25 less than a trap plus a separate strainer. Look over your small trap applications and order the traps you need now from your local Armstrong representative's stock.

ARMSTRONG MACHINE WORKS
812 Maple St., Three Rivers, Mich.

THE No. 880 is available with ½" or ¾" connections for operating pressures to 150 psi; 450 to 690 lbs/hr continuous discharge capacity. 5⅞" high; 5" diameter; weight 5 lbs. One of a complete line of traps described in the ARMSTRONG STEAM TRAP BOOK. Send for your copy.

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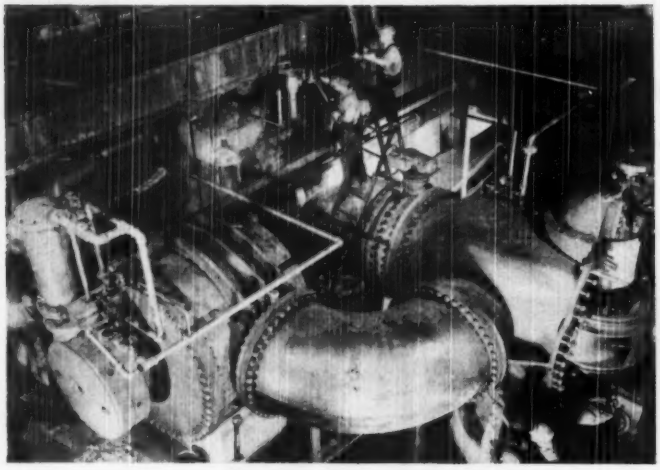


Flood-Proofing for Pumping Plants

Pittsburgh's Ross pumping station will soon have a centrifugal pump that will deliver 100 mgd of raw water to a filtration plant regardless of river condition. Dravo Corp is installing this pump, which was built by DeLaval Steam Turbine Co. It is designed for a 58-ft head, has a 54-in. suction and 48-in. discharge. It is driven by a 1250-hp synchronous motor mounted on a reinforced concrete platform and has a hydraulically operated cone check valve in the discharge line that supplies a filtration plant

COMING EVENTS

April 5-7—Midwest Power Conference, Sherman Hotel, Chicago, Ill.; Dr R E Whitehead, secy, Illinois Institute of Technology, 3300 S Federal St, Chicago 16, Ill.

April 10-12—American Society of Lubrication Engineers, Detroit, Mich.; W F Leonard, secy, ASLE, 343 S Dearborn St, Chicago 4, Ill.

April 12-14—American Society of Mechanical Engineers, spring meeting, Statler Hotel, Washington, D. C.; O B Schier, ASME, 29 W 39th St, New York 18, N. Y.

April 19-20—American Institute of Electrical Engineers, Power Conference, Wm Penn Hotel, Pittsburgh, Pa. R S Gardner, AIEE, 29 West 39th St, New York 18, N. Y.

May 3-5—Technical Air Pollution Conference, Dept of Interior, Washington, D. C.; Sid Gotlieb, chairman, Room 4419, Bureau of Mines, Washington, D. C.

May 21-25 — Smoke Prevention Assn of America, Mount Royal Hotel, Montreal, Can.

May 23-26—National District Heating Assn, annual meeting, Grove Park Inn, Asheville, N. C. John F Collins, Jr, secy-treas, 827 N Euclid Ave, Pittsburgh 6, Pa.

Atomic Energy's Here to Stay

The seventh semiannual report of the Atomic Energy Commission indicates that atomic energy is an industry in itself and is on a sound footing.

The nuclear reactor program has begun to hit its stride. In November, the Commission authorized the building of the first breeder reactor. This is the crossover point from the blueprint to actual construction. There are now three reactors, including the breeder, well along in design or already under construction in Idaho. General Electric is building a fourth near Schenectady.

The breeder reactor is of an experimental nature. It will test the possibilities of transforming nonfissionable materials into fissionable and, at the same time, creating fissionable material in excess of what is consumed.

General Electric's reactor will bear close watching. It is an intermediate power breeder—first in the intermediate energy range. Its job is to produce sizable amounts of electric power by a utilization of neutrons in the intermediate energy range, and to breed fissionable materials while developing electrical power Heat energy will be removed by molten metal and applied to power generation by conventional means.

Still another—the homogeneous reactor—was described in the report and is now in the early planning stages. With this one, the fuel, moderator, coolant, all mix together. Principle is that the nuclear reaction, removal of energy, reprocessing of nuclear fuel can all be combined in one unit. This arrangement would permit reprocessing the nuclear fuel as the operation goes along rather than in usual batch lots.

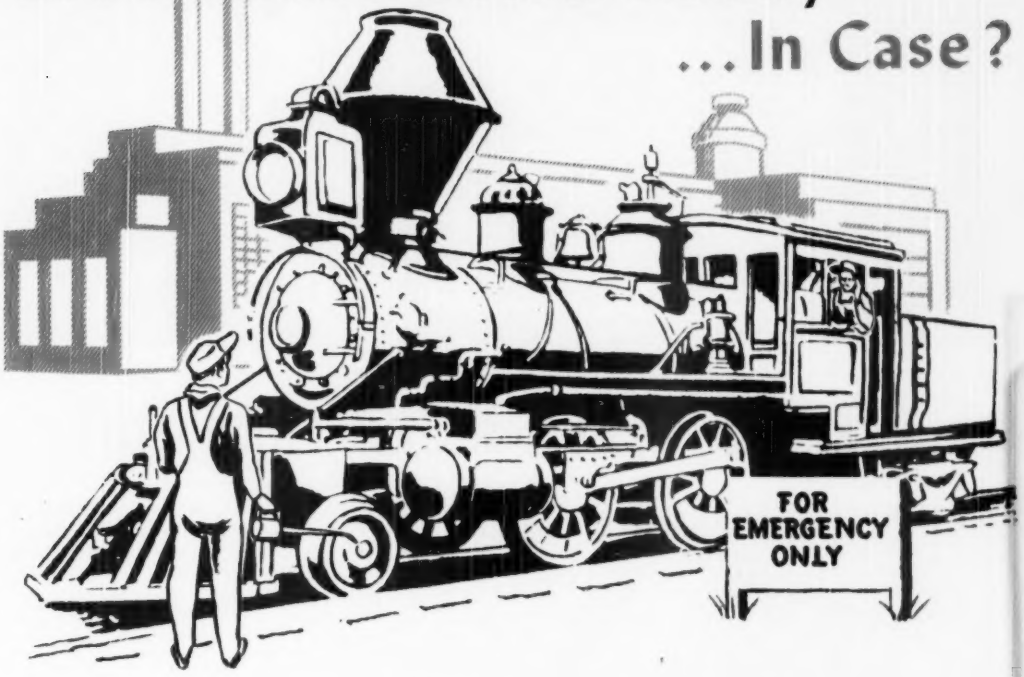
Carroll Wilson, general manager, AEC, has likened the homogeneous principle to the continuous-process catalytic cracker in the petroleum industry. "You just run the liquid around," he said, "and bleed off some partially depleted material and feed in some new stuff rather than have it set for a while and push it out and then put in new stuff. It is a continuous process."

Production-wise, the commission had a very favorable report. Through foreign agreements and mining and processing plant developments in the U.S. an adequate supply of uranium has been assured. Five plants for uranium production from domestic ores are now operating on the Colorado plateau and a sixth will be going in a few months.

Stockpiles have been increased for both feed and intermediate products.

(*Continued on page* 206)

Got a Locomotive Handy ...In Case?



EVERY so often a steam locomotive makes news by going to the rescue of a plant where the steam system gave out at a critical time.

This is one answer to continued steam production pending repairs . . . and undoubtedly an expensive one. Simplest—and most economical—is to use the Nalco System and eliminate the chances of boiler down time due to faulty water treatment.

Nalco chemicals and services aim at *water treatment results* from raw water intake to condensate hot well . . . And the thousands of plants now using the Nalco System testify to the accuracy of this aim during the past twenty-six years. Whether your plant is large or small; your water problems scale, corrosion, carry-over—or just plain high cost—unless you have a locomotive handy for emergencies, better check with Nalco today. No obligation . . . and an excellent chance for permanent water treatment security.

P. S. More steam locomotives use Nalco-treated water than any other kind . . . Perhaps the reason why locomotives *can* be of help in plant emergencies!

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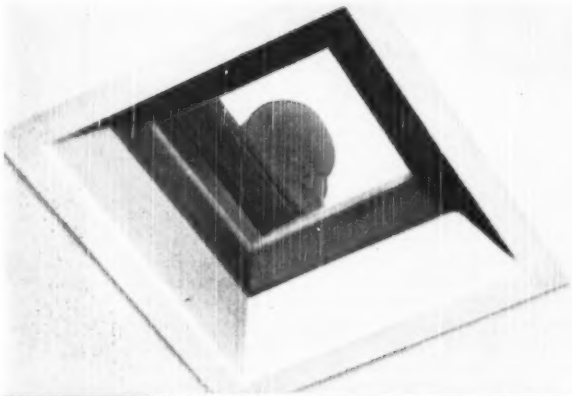
THE *Nalco* SYSTEM . . . Serving Industry through Practical Applied Science

Keep It Clean
WHEN John A. Hill installed his first printing plant, he ordered that the machinery, printing presses and all, should be painted white.
It was an unheard of thing for a print shop which was proverbially cluttered, ink-besmeared and dirty.
"How am I to keep it clean?" asked the bewildered foreman.
"Don't let it get dirty!" was the reply.
And it stayed immaculate. The first smooch of ink upon the white enameled frame was immediately cleaned off, and knowing that this would have to be done, other smudges that would have accumulated upon an already besmeared surface were avoided.
When a room is clean and well kept, and orderly, one hesitates to damage it. He will not throw a handful of clutter upon a well-swept floor nor start to mess up things that are in a quick and spare condition.
Things will stay clean a whole lot easier if you don't let them begin to get dirty.
Some men's plants are so clean and neat and quiet running and free from leaks that a little clutter or disorder, a slight pound, a drip of steam or oil or water stands out conspicuous and demands attention. Their machinery looks as nice and runs as well as it did when it was new.
The same principle applies in immaterial things, in one's habits of life, in his thinking. Start with a good clean outfit and don't let it get dirty.
—F. R. Low

KEEP IT CLEAN–INSIDE AND OUT



► THE LATE FRED LOW, POWER'S pioneer editor, beloved from coast to coast, and still remembered by oldtimers, was much given to sound thinking and plain talk.

On a recent visit to National Cash Register in Dayton, Editor Phil Swain saw proof that in the minds of power men the wisdom of Fred Low still lives on. Low's foreword, "Keep it Clean," framed and in jumbo type, hangs on the wall of the spotless turbine room.

Plant Engineer Ed Smith, shown above looking at the editorial, is a man who understands the practical wisdom of words like these:

"Things will stay clean a lot easier if you don't let them begin to get dirty.

"Some men's plants are so clean and neat and quiet running and free from leaks that a little clutter or disorder, a slight pound, a drip of steam or oil or water stands out conspicuous and demands attention. Their machinery looks as nice and runs as well as it did when it was new.

"The same principle applies in immaterial things, in one's habits of life, in his thinking. Start with a good clean outfit and don't let it get dirty."

National Cash has always been Dayton's "leading citizen." That's why its power plant must be clean inside and out—all the way from turbine-room floor to stack top. And that's why B Tate Jr, chief engineer of the power plant, has placed a window in the ceiling of his office so he can watch the stack top for smoke without even leaving his chair.

The New JENKINS PLUG TYPE ARMOR SEAT VALVE

TAMES THE TOUGHEST VALVE SERVICES IN INDUSTRY

SETTING RECORDS FOR LONG LIFE AND LOW MAINTENANCE

For Severe Services like . . . **PRESSURE REGULATION STEAM CONTROL-BY-PASS LINES-TEMPERATURE REGULATION APPARATUS THROTTLING • BLEEDS, DRIPS, DRAINS • SOOT BLOWERS • CONTINUOUS BOILER BLOWDOWNS • OPEN BLOWS ON BOILERS-ANY CLOSE REGULATION OF STEAM**

In Many Industries like... **DYE WORKS • BLEACHERIES BREWERIES • OIL REFINERIES • CREOSOTING PLANTS • PACKING HOUSES • MILK PLANTS • PLASTIC MOLDING PLANTS • HAT FACTORIES • GAS WORKS • TANNERIES • SUGAR REFINERS BOILER PLANTS • RUBBER MILLS**

Do YOUR piping systems include valve-killing services that build up excessive maintenance and replacement costs? If so, the new Jenkins Fig. 976-A Plug Type Bronze Globe Valve will produce important savings for you.

Install it where "wire drawing", due to close control of steam, knocks out other valves quickly—where entrapped chips, rust, or scale score the seats and start leaks. See how it defeats the worst valve enemies . . . how it sets new records for endurance and economy.

HERE'S WHY

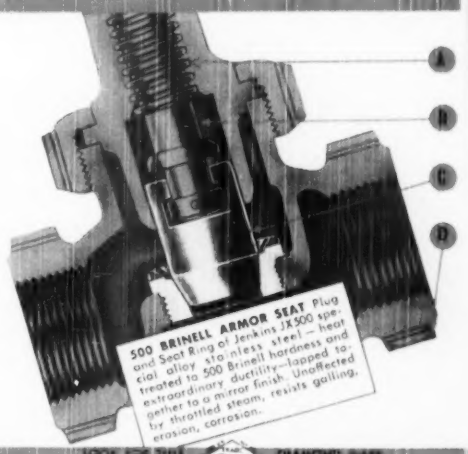
The stout "heart" of the Fig. 976-A is the stainless steel plug and seat ring, *hard enough* (500 Brinell) to smash steel pipe chips without scoring, yet *tough enough* to take a nine ton load without cracking. Other features are . . .

(A) MORE THREADS, LESS WEAR—Additional threads in bonnet and on spindle assure full thread engagement (open or closed), less load, less wear per thread.

(B) NEW "TUFFARD" SPINDLE—Aluminum bronze (tensile strength exceeds 65,000 lbs.)—tough to take stresses, yet hard for long wear. Bigger in diameter, with more strong threads.

(C) NEW SLIP-ON, STAY-ON PLUG—Simple design with T-slot for engaging spindle head is stronger, trouble-free, and permits free flow. Mirror-finished bevel assures perfect mating with seat ring.

(D) NEW STURDY LUGS—Flat-faced, V-shaped lugs on union bonnet ring and body ends, permit firm fit and grip of open end, pipe or monkey wrench—withstand repeated disassembly.


A
B
C
D
500 BRINELL ARMOR SEAT Plug and Seat Ring of Jenkins JX500 special alloy stainless steel—heat treated to 500 Brinell hardness and extraordinary ductility—lapped together to a mirror finish. Unaffected by throttled steam, resists galling, erosion, corrosion.

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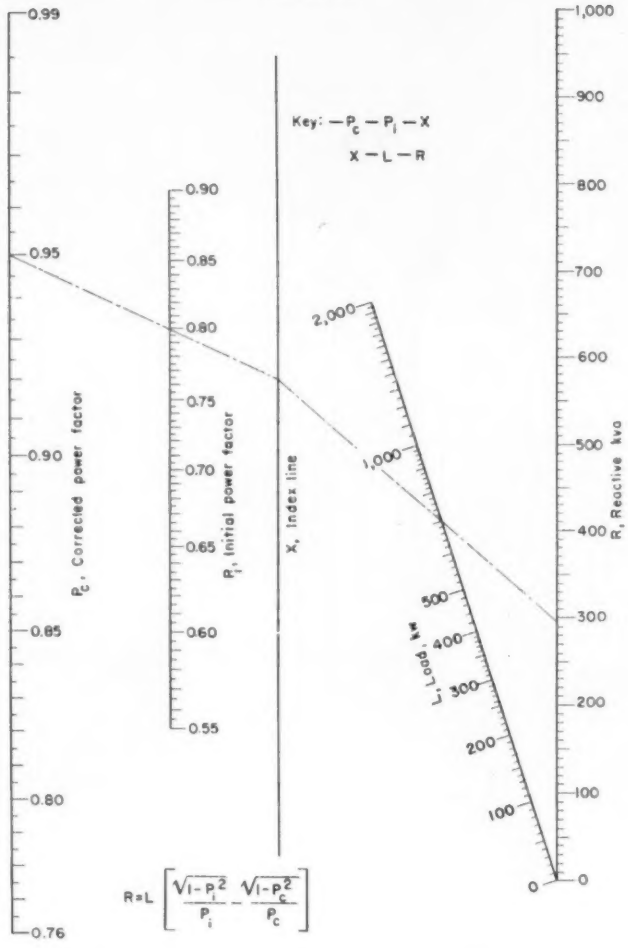


Figuring Reactive Kva

► HERE'S A CHART for finding the amount of reactive kva supply needed to improve the power factor of a load. Either a capacitor or a synchronous condenser can produce reactive kva. Chart is based on the formula given at the bottom. Here R is the reactive kva, L the load in kw, P_i the initial power factor, and P_c the corrected or improved power factor.

Example: Load with a total of 700-kw demand has a power factor of 0.8 at this magnitude. How much reactive kva must be supplied to improve the power factor to 0.95?

Lay a straight edge from 0.95 on the P_c scale to 0.8 on P_i scale. Find the intersection with the index line. From here, lay the straight edge to intersect with 700 on the L scale and find the answer, 296 kva on the right-hand scale.

By applying multiples of 10 to the kw-load scale it can be made to cover any range. For example, if the load is 7000 kw, reactive kva is 2960. Similarly, if the load is 70 kw, the answer is 29.6 kva. That is, cut off or add equal number of zeros to both L and R scales.

BY JOHN F HYAM *Sarnia, Ontario*

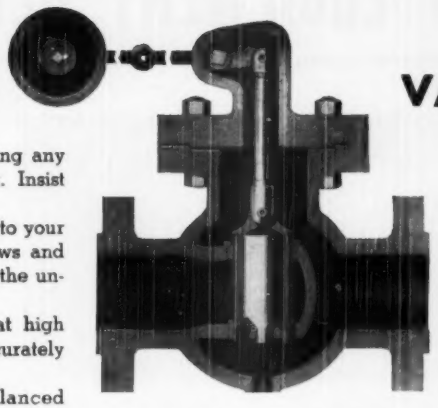
COPES BALANCED VALVES

Wherever you use float valves, avoid losing any of your operating force in the stuffing box. Insist on low and constant valve stem friction.

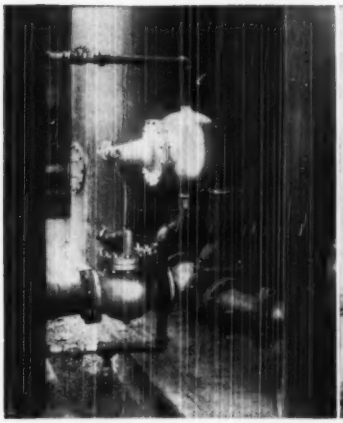
Make sure of instant, accurate response to your actuating force—no matter what your flows and pressures—by demanding close control of the unbalanced forces found in every valve.

Provide for minimum pressure losses at high flows by requiring your valve ports to be accurately designed for the conditions you specify.

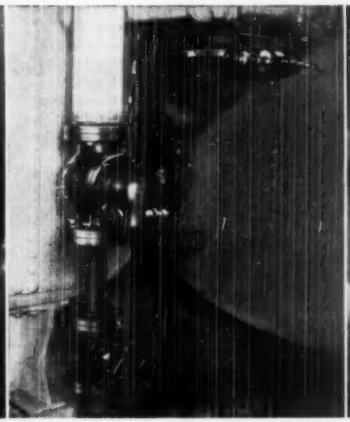
In other words—insist on COPES Balanced Valves. They offer all these important advantages —plus long service life with minimum maintenance. Write in detail about your needs.



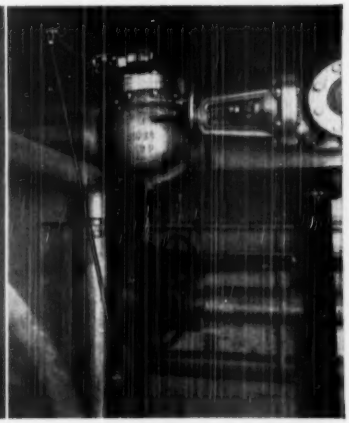
With the COPES Type BI Valve, rotating stem means low stuffing box friction. Accurate balance assures quick and accurate response. Exact capacity you need is provided.



Float-operated COPES Type BI Valve controls flow of condensate from flash tank to storage tank.



Flow of blow-down water from a flash tank is controlled by this float-operated COPES Valve.



Water level in a deaerating heater is controlled by this float-operated COPES Balanced Valve.

NORTHERN EQUIPMENT COMPANY

401 GROVE DRIVE, ERIE, PA.

BRANCH PLANTS: Canada, England, France, Italy and Austria. *Representatives everywhere.*

Bulletin 443-B gives condensed data on all major COPES products. Write for a copy—your letterhead, please. Keep it for reference.

COPES

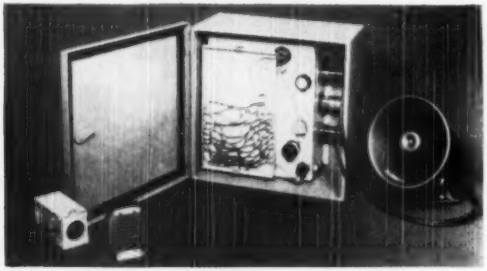
Headquarters for . . .

Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

PLANT EQUIPMENT NEWS

Published monthly as a service to readers

Your information center for new products to solve plant problems. Spot what you need, use handy cards to request more details



RECORDING AND REPRODUCING THE VOICE OF SAFETY

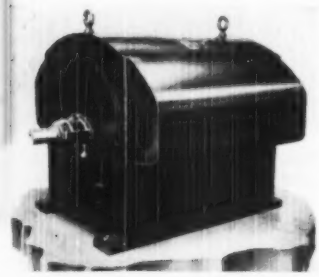
P401 • *Saf-T-Vox* is a small, compact electronic unit for recording and reproducing safety messages. Developed at General Electric's Electronic Park, it is adapted to the field of industrial safety.

Device enables the plant safety man to deliver his verbal warning at the danger point *before* the danger moment. Unit records his message and reproduces it whenever and wherever he desires. It speaks for the safety man as if he were there.

It employs a simple mechanism for handling a magnetic tape on which messages are recorded, an amplifier, a loudspeaker and a starting trigger. No resetting or rewinding is necessary. *Saf-T-Vox* is always ready to speak when its starter is tripped, by interception of beam or otherwise.

Unit is flexible and economical in operation. Ten messages of ten seconds duration each can be repeated one at a time as the device is started.

American Allsafe Co, Inc, 1245 Ningara St, Buffalo 13, N.Y.

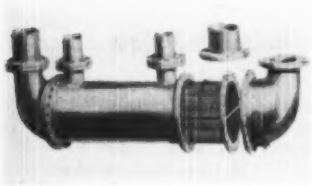


SPLASHPROOF MOTOR P460

Built in sizes from 150 to 2000 hp, 4 to 14 poles, this motor is designed for outdoor steam-generating stations and open-air process plants. Ventilating system has straight-through inlet and discharge openings on both ends of motor. Foreign matter blown into ventilating openings is deflected by a series of baffles, and either drains out or travels straight through.

Foundation for this motor may be a simple concrete slab. Sealed, split, ring-oiled, sleeve or antifriction bearings are available.

Elliott Co, Ridgway Div, Ridgway, Pa.



HEAT EXCHANGER P422

Type R, removable bundle shell and tube heat exchanger is available from stock in both single- and 2-pass models.

Tubing is corrosion-resistant Admiralty. Tubes are put up in larger sizes, ⅜- and ⅝-in. OD, with engineered tube spacing and baffling to give a longer unit life, easier maintenance, and maximum heat transfer.

Young Radiator Co, Racine, Wis.

PHOTOELECTRIC-CELL HEAD P473

Designed particularly for heavy industrial service where space is at a premium. No coaxial or shielded cable is necessary since amplifier is in same housing as phototube.

Companion unit houses a light where shots across a gap are required. Another type houses both the light source and photo pickup for reflected light, as in registration, counting, etc. Depth of unit is 6x3½x1¾ in.

Ess Instrument Co, 96 S Washington Ave, Bergenfield, N. J.

HYDRAULIC FILTER P464

Micronic filter, suitable for pressures of 3000 psi, is designed to remove particles as small as 40 microns from hydraulic systems. Pressure drop is 25 psi at 10 gpm using SAE 20 oil. Device protects valves, pumps and cylinders from foreign materials. Elements are replaceable.

Waterman Engineering Co, 721 Custer Ave, Evanston, Ill.

BOILER-FEED PUMP P444

Unit of regenerative turbine type has mechanical pressure seals and permanently lubricated ball bearings. Seals are developed to operate under conditions of high pressure and temperature, found in small-boiler feed service Equipped with synthetic-rubber sleeves seal, unit seals against leakage in pump box and along shaft.

Tension on sealing surfaces adjusts automatically in proportion to internal pump pressure. Diaphragm and spring arrangement is built into rotating member of seal, compensated for normal axial misalignment. Special seals keep all dirt and grit out of bearings and the grease in, so the original charge in each bearing lasts the life of the pump.

Fred H Schaub Engrg Co, 2110 S Marshall Blvd, Chicago 23, Ill.

BELT FEEDER P446

Originally designed to deliver continuous stream of material from an intermittently discharging automatic bulk scale, this unit has a wide range of applications as a feeder or take-away conveyor. Variable-speed drive can be furnished, which is automatically adjustable to vary the stream to conform with the timed discharges of the automatic scale above, and so maintain a continuous, accurately weighed stream. It also features cantilever pulleys for endless belting and removable skirt plates.

It is available in lengths from 18 to 60 in., and in stream widths of 2, 4 and 6 in., with rated capacity up to 1500 cu ft per hr. Belt speed is from zero to 200 ft per min. It can be driven (1) by single-speed motor at either end (2) from line shaft (3) by

For further data on above items use reply cards on page 198a, identifying your request with letter P and number

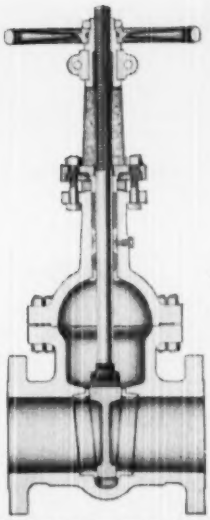
For completeness of selection You can't beat the CRANE line

STEEL VALVES FOR POWER PIPING SERVICES

Crane Cast Steel Wedge Gate Valves find wide application wherever exceptionally rugged and durable steel valves are required. Body and bonnet have heavy metal sections and ample reinforcements at points under greatest stress. Straight-through ports assure minimum turbulence, erosion, and resistance to flow.

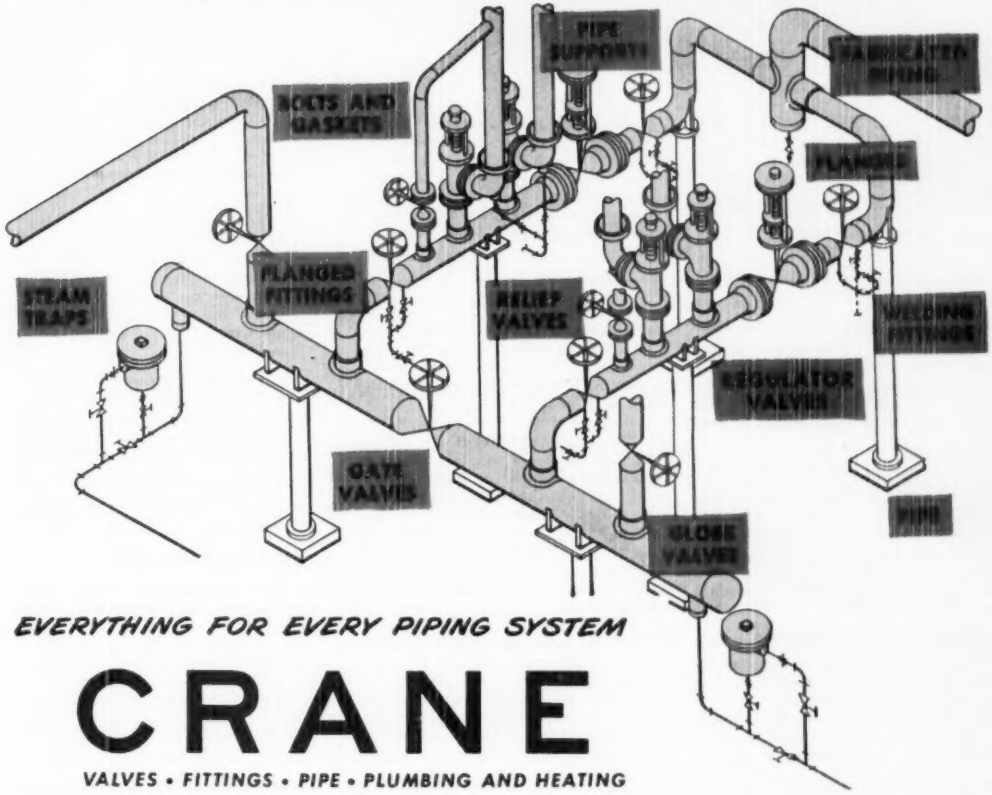
Solid wedge disc with close fitting disc guides maintains accurate seating on shoulder-type screwed-in body seat rings. "T-head" disc-stem connection prevents side strain on stem. Available in pressure classes from 150 to 1500 pounds with a variety of trim materials especially suited for recommended services. Flanged or welding ends up to 24 in.; screwed ends up to 4 in. See your new No. 49 Crane Catalog, p. 226-232.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving ALL Industrial Areas



No. 33XR, 300-Pound Steel Gate for steam up to 850° F.; for water, oil, air or gas up to 500° F. Exelloy to Nickel Alloy seating. Sizes: 1½ to 24 in.

ONE ORDER TO CRANE COVERS ALL PIPING EQUIPMENT FOR THIS PRESSURE REDUCER STATION, FOR EXAMPLE



EVERYTHING FOR EVERY PIPING SYSTEM

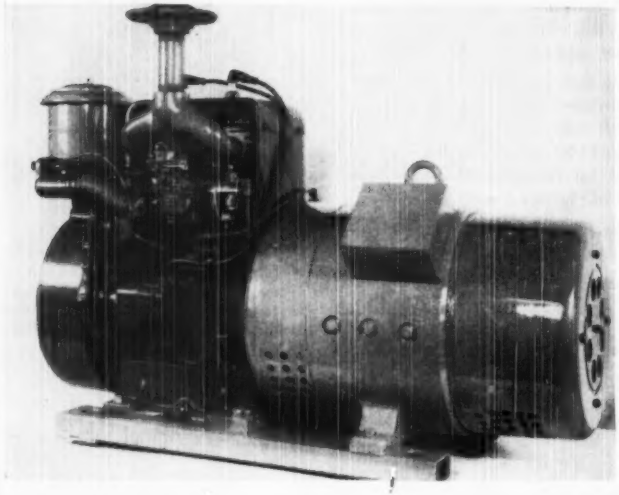
CRANE

VALVES • FITTINGS • PIPE • PLUMBING AND HEATING

special, infinitely variable-speed drive when specified. Manual control or special remote control, up to 30 starts per minute, is also available.
Richardson Scale Co, Clifton, N. J.

AIR DIFFUSER **P420**

Acoustical, ceiling air diffuser is joined with a square panel of lightweight metal to blend in with ceiling. Diffuser retains all standard features of the company's *Kno-Draft* line of adjustable air-discharge and air-volume control units.
W B Connor Engrg Corp, 116 E. 32nd St, New York 16, N. Y.



STANDBY LIGHTING PLANT **P458**

Electrical plant is powered with 2-cylinder air-cooled engine. Unit is equipped with a magneto, permitting hand cranking; there is no need for batteries.

Generator has a rated capacity of 5 kw. It starts single-phase motors up to 3 hp. These standby power plants are designed for continuous operation. *Katolight* generators are built in 1200, 900 and 720 rpm, in capacities from 500 watts to 300 kw at 60 cycles. They are also available in frequencies ranging from 25 to 400 cycles.
Kato Engineering Co, Mankato, Minn.

GAGE BLOCK SET **P467**

Accessory set No. J-19 for use with all makes of precision gage blocks has jaws, straight edges, adjustable holders in various sizes as well as a center point and scriber to increase application of gage blocks.

Jaws come in six sizes, with over-all lengths of 1¾-, 1¾-, 2- and 2⅞-in. solid design and 5⅛- and 6-in. I-beam design. These jaws allow the use of temporary limit gages for external and internal measurement. Two straight edges are included (4-blade type); three adjustable holders.
Jansson Gage Co, 19208 Glendale Ave, Detroit 23, Mich.

MAINTENANCE COATING **P469**

A vinyl coating, *Styrenated Acid-Causticbond*, can be applied over damp and rusted surfaces, eliminating sandblasting.

The new formula gives a tough, chemical-resistant, air-dry paint film. Dried paint has no odor, taste or toxicity. It is said to resist flame-spread, fungus growth.

Paint can be applied by brush or spray. If a brush is used clean with turpentine.
Wilbur & Williams Co, Greenleaf and Leon St, Boston 15, Mass.

AC TO DC CONVERTOR **P463**

Varicell provides a stabilized and regulated source of variable dc voltage from ac power source. It operates from a 95- to 135-v, 60-cycle, single-phase, ac line, and delivers a dc output that is variable from 0 to 30 volts. Allowable output current, available at any voltage setting, is 15 amp.
The Superior Electric Co, Hannon Ave, Bristol, Conn.

LIGHTING TRANSFORMER **P448**

Redesigned line of dry-type general-purpose lighting transformers permit greater circulation of air through and around the unit, resulting in lower operating temperatures.

Use of Class B heatproof materials such

(*Continued on page* 152)

Don't Miss...

. . . **Dc Arc Welder** driven by air-cooled engine with magnetic ignition. Welder weighs 1050 lb and has rated output of 200 amp at 40 v..... page 190

. . . **Powerhouse Cement** has low shrinkage and is weather resisting. Okay for service up to 1700 F..... page 192

. . . **Pressure Regulator** suitable for oil-fired burners with gravity feed. Standard ⅛-in. orifice may be increased to deliver quantity of fuel needed. Regulator setting may be adjusted in field ..... page 192

. . . **Steam-Cleaning Machine** removes grease, grime and dirt from machinery. Unit may be changed over to heating generator with 850,000-Btu-per-hr output. Operating pressure reached within 2 min from cold start ..... page 194

. . . **Swivel Pipe-Coupling** handles fluids under high pressure through pipe that rotates full 360 deg in all directions. Coupling is designed for an average rotation not exceeding 60 rpm ..... page 196

. . . **Hot-Water Heater** supplying 3960 to 31,500 gal per hr. Steam is fed into unit at top and directed through an assembly of tubes that act as injectors. Cold water, entering from side, is caught up in the suction created by the moving steam..... page 194

. . . **Power-Plant Motor** is base ventilated and designed for driving outdoor power-station auxiliaries. Motor is available in ratings from 200 to 3000 hp. Unit was developed for those outdoor installations where totally enclosed fan-cooled units are not available ..... page 198

. . . **Panel Instruments** that are rugged enough to stand up under 2000 ftlb blows while mounted in panels. On top of that, they get a 6-hr vibration test from the manufacturer. These instruments have a permanent-magnet moving-coil element ..... page 198

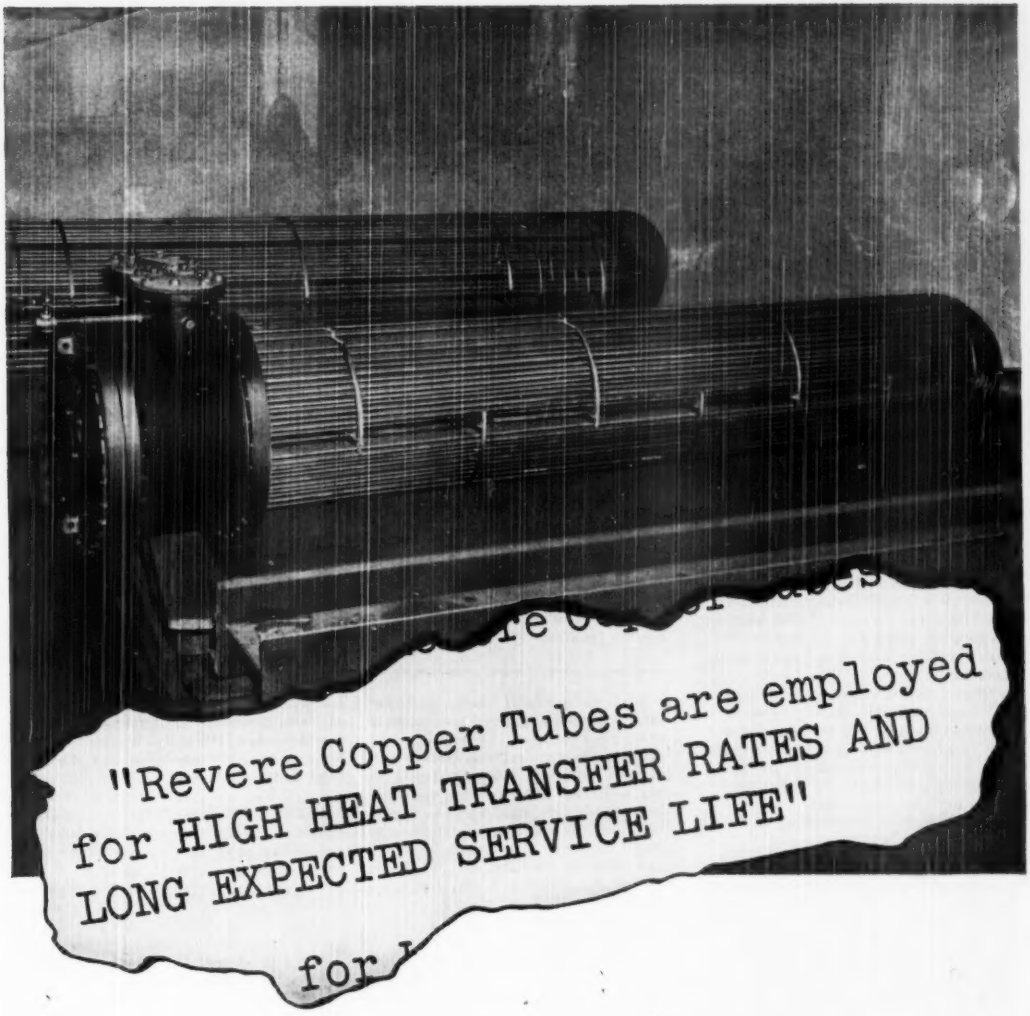
. . . **Ammonia Compressors** designed with 4 to 16 cylinders for direct connection to motor. Units are rated 15 to 275 hp. Cylinder liners, other wearing parts can be replaced ..... page 198

. . . **Flyash Collector** for the small steam plant of 3500- to 7000-lb-per-hr capacity ..... page 190

And Next Month . . .

. . . **Heat Insulation** of reflective metal for surfaces whose temperature ranges from sub-zero to more than 1000 F. It consists of several layers of medium-gage aluminum-alloy sheets, mechanically held by nonconducting spacers to prevent metal contact and maintain uniform air spaces. Makers claim heat loss less than same thickness of standard commercial insulations

For further data on above items use reply cards on page 198a, identifying your request with letter P and number



The above quotation is from a letter by the Struthers Wells Corporation, Warren, Pa., accompanying the picture shown above. The picture shows two boiler feedwater heaters, intermediate and low-pressure, made by Struthers Wells for the generating station of a large public utility. These two tube bundles contain Revere deoxidized copper tubes, made to ASTM Specification B-111. One uses ¾" O.D. x #18BWG tube, while the other has tube ⅞" O.D. x #18 BWG. It will be noted that some of these tubes are bent to a small radius; superior bending quality is one of the features of Revere Copper Tube supplied for such purposes . . . In addition to copper tube, Revere offers for condenser and heat-exchanger service tubes in all the customary copper alloys, such as Admiralty Metal, Muntz Metal, the brasses and bronzes, and the cupro-nickels . . . For true economy it is important to select the correct size and alloy to meet actual conditions of use. Revere will gladly collaborate with you in such selection, whether for new equipment, or for re-tubing.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere.

as *Fiberglas*, mica, asbestos etc, has resulted in greater overload capacity, as well as longer life during normal operations. This line, designated as Type C, is available from stock in single-phase ratings of 480/240 - 120/240 v, up to and including 15 kva; also in 3-phase ratings of 240 or 480 v, on primary, and 120/208 Y, 4-wire on secondary.

Marcus Transformer Co, Inc, 32-34 Montgomery St, Hillside 5, N.J.

ARC-WELDING ELECTRODE P466

Reverse-polarity dc arc-welding electrode, W-22, (AWS Class E 6010) has been designed for vertical and overhead welding of all joints in mild steel.

High tensile strength and ductility with good impact resistance feature the W-22 welding bead. New electrode may be used for repair welding of castings because of its low-volume slag-forming characteristics.

General Electric Co, Apparatus News Bureau, Schenectady 5, N. Y.

FILTER WITH V-DISKS P419

Series of V-shaped, horizontal filter disks, bolted onto the cover of a filter housing, remove solids down to 1 or 2 microns from liquids, separate water from fuel oil, purify gases.

V-shaped disk is made up of two perforated leaves separated at the center by a perforated flange. Leaves are covered with a filter media-synthetic rayon, nonwoven cloth, resin-treated filter paper, etc. Filter housing is high-pressure cast aluminum; all contact parts are rustproofed.

Sparkler Mfg Co, Mundelein, Ill.

GROUND DETECTOR P456

Permits detection and location of ground faults on undergrounded electrical distribution systems while all circuits are "hot" and equipment is operating. Apparatus consists of a signal generator and hand-receiver instrument. Generator superimposes a pulsating alternating signal current (50 times per min) on grounded phase conductor.

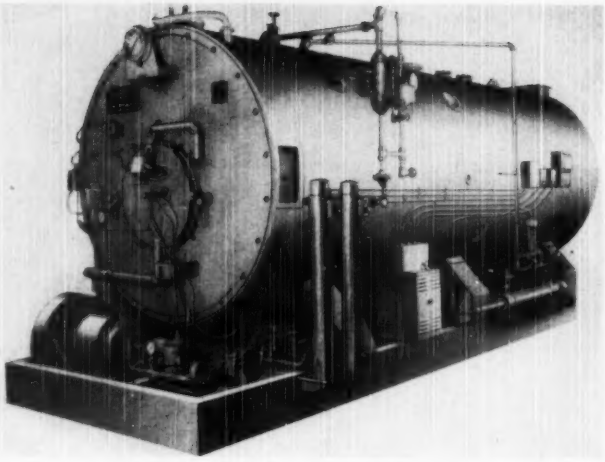
Fault is located by passing signal receiver (similar to clamp-on ammeter) along feeders, distribution cabinets and branch circuits to equipment. Microammeter in receiver picks up signal current and gives pulsating indication until point of ground fault is reached where needle remains stationary.

Excel Electric Service Co, 2125 S. Western Ave, Chicago 8, Ill.

ANTI-RUST PAINT P410

Rustrem clear anti-rust paint can be brushed or sprayed directly over rust without wire brushing or scraping. Can be covered with any good quality paint except lacquer and will not bleed through painted surfaces. Available in quart, gallon and 5-gallon cans and 55-gallon drums.

Speco, Inc, 7308 Associate Ave, Cleveland 9, Ohio.



STEAM GENERATOR P432

Further addition to company's automatic, packaged boilers, the new 17,500-lb-per-hr, *Amesteam*, is available in pressures from 15 to 200 psi, for firing with oil or gas.

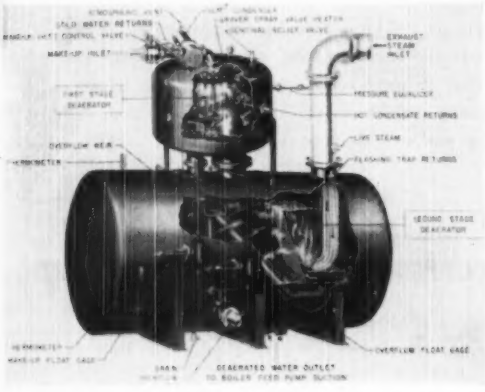
Unit is complete, ready for installation. Connections, to steam, water, fuel or electric lines, breeching or stack, make the unit ready for operation. Furnace and tubes are so arranged that all heating surfaces get smooth flow of hot gases over them.

Ames Iron Works, Oswego, N. Y.

PROTECTIVE COATING P415

Dampney *Vinyl Coating* resists alkalis and mineral acids, and is recommended for operating temperatures of minus 40 F to 160 F, wet or dry. Material is insoluble in alcohols, greases, oils and aliphatic hydrocarbons, and has low permeability to water vapor. An applied film, which is non-flammable, imparts no taste, odor or toxicity. Air dries within an hour. Available in a

(*Continued on page* 154)



DEAERATING HEATER P351

Two-stage deaerating heater reduces oxygen content for feedwater to less than 0.005 ml per liter measured by the ASTM Referee Method or modified Winkler test regardless of load variations or unusual operating conditions. Carbon dioxide is also completely removed.

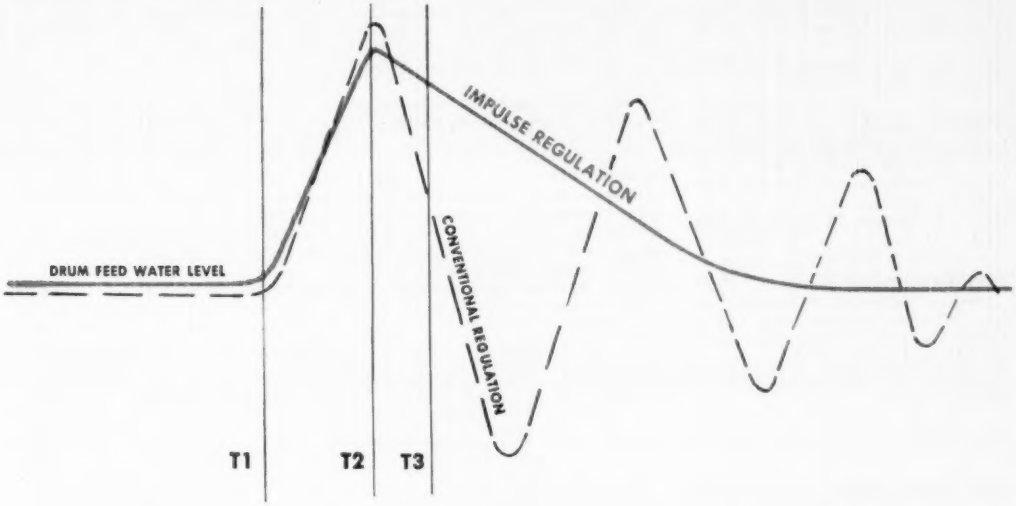
Spring-load self-adjusting spray valves in the first stage cause heating of incoming water to within 2 to 4 deg of the steam, which removes virtually all oxygen and free CO_2. This preheated water is intimately mixed with incoming steam in the second stage by means of specially designed scrubbing baffles, which remove last traces of undissolved gases. Remaining vapor then goes to first stage where it preheats incoming water.

Countercurrent flow of steam and water accomplishes complete deaeration with minimum steam. Heaters are available in all sizes up to 2,000,000 lb per hr. Second stage of each heater is tailor-made for individual plant conditions and for the desired storage capacity.

Graver Water Conditioning Co, 216 W. 14 St, New York 11, N. Y.

For further data on above items use reply cards on page 198a, identifying your request with letter P and number

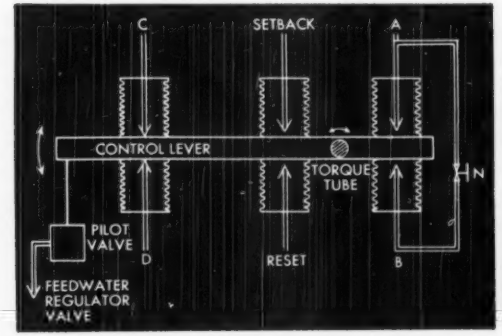
Control feed water level accurately during QUICK load change T_1T_2 with IMPULSE regulation



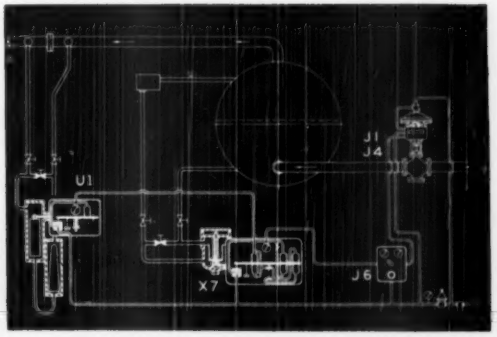
1 **COMPARE** that solid red line with the s-u-r-g-i-n-g feed water level represented by the dotted black line. Trouble is that conventional two-element systems, once adjusted for a given rate of change T_1T_2, merely react to magnitude of steam load without being able to compensate for a *different rate of change in load* T_1T_2. Since "shrink and swell" and resulting false drum level are functions of rate of change as well as magnitude of load, only Swartwout impulse regulation acts instantly and positively for *any rate of change in load* of any magnitude.

Swartwout

POWER PLANT EQUIPMENT



2 **DIFFERENTIAL LEVEL AND IMPULSE CONTROL** has setback bellows for wide throttling range and stability; reset bellows for constant level regardless of load. Bellows A, B and needle valve N, which comprise the impulse unit, convert air pressure proportional to load magnitude into an impulse reflecting *rate of change* as well as magnitude of load. This impulse cancels out drum "shrink and swell" effect (transmitted by torque tube) which is also based on rate of change and magnitude of load. Adjustment for varying water level with load is effected by bellows C, D if desired.



3 **SQUARE ROOT** of steam line orifice differential is taken by U1 flow transmitter which feeds air loading pressure proportional to steam flow into X7 differential level and impulse control. Regulating valve is equipped with J1 Positioneer and J4 air lock. J6 panel shows intermediate and manual pressures, provides for manual and automatic operation. In addition to this FW6 two-element impulse system, Swartwout also makes an FW7 three-element impulse feed water regulating system. Other types include the FW5 single-element system and SC (FW1) thermo-hydraulic system. A-6023

SEND FOR BULLETINS S-27, S-20-E. THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

EQUIPMENT NEWS *CONTINUED*

clear black or gray high-gloss finish; other colors may be formulated to meet special requirements. One gallon covers about 400 sq ft.
Dampney Co of America, Hyde Park, Boston 36, Mass.

BRAZING ALLOY P405

Silver brazing-alloy package contains 5 oz of 1/16-in. dia *Easy-Flo-45* wire. Torch-brazing instructions and a *Quick Facts* folder are included.
Handy & Harman, 82 Fulton St, New York 7, N. Y.

FIRE EXTINGUISHER P441

Compact, lightweight extinguisher contains 6 lb of nontoxic, nondamaging carbon-dioxide gas. Unit has thumb-trigger release and self-aimed nozzle.
Randolph Laboratories, 8 E Kinzie St, Chicago 11, Ill.

STRIP-CHART RECORDER P407

Pneumatic *Capacilog* air-operated device measures temperature, speed, flow, pressure, voltage, amperes, etc. Control function is performed by the Wheelco *Electronic Link* operating diaphragm motors connected to valves, dampers, levers, pistons, etc. Unit is self-contained and has only two external air connections.
Wheelco Instrument Co, Advertising Dept, 847 W Harrison St, Chicago 7, Ill.

FILTER UNIT P411

Surfamax porous stainless-steel filters supply maximum filter area in a convenient small container. Filter elements are in the form of corrugated assemblies, available in 6-pore openings ranging from 5 to 165 microns. Standard units with pipe connections ranging from ¼ to 2 in. are available. Others can be supplied on special orders up to 10-in. pipe size and in capacities up to 10,000 gpm.
Micro Metallic Corp, 193 Bradford St, Brooklyn 7, N. Y.

COAL-CAR THAWER P436

Portable, trough-like deicer fits on rails beneath coal-car hopper. It burns waste oil or No. 2 oil, and throws off enough heat to melt any ice in the car pocket.
J C Corrigan Co, Inc, 41-47 Norwood St, Boston 22, Mass.

OIL BURNER P435

Single burner with built-in dual pump and reservoir, the AR-144, size 10, has a compensating viscosity-control valve, thermostatically controlled electric pre-heater, dual ignition, all in one unit. Burner is rated at 210 gal per hr of No. 6 oil, enough for 24,400 lb of steam per hr.
Ray Oil Burner Co, 410 Bernal Ave, San Francisco 12, Calif.

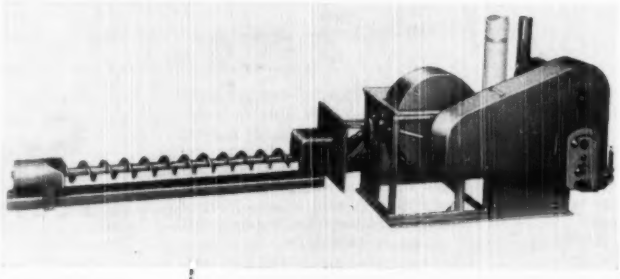
MAGNETIC SWEEPER P440

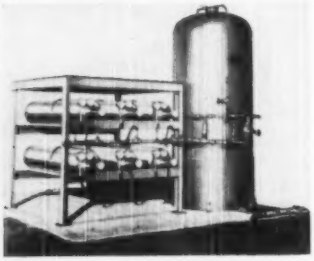
Stray nuts, bolts, screws, etc, can be picked up easily with the 12-in. *Magimmick* magnetic sweeper that moves on fiber wheels.
Ullman Products Corp, 152 Prospect Ave, Brooklyn 15, N. Y.

SPREADER STOKER P438

Complete firing system—from bunker pickup, drying and conveying to coal burning—features the Series 400 pneumatic spreader stokers.

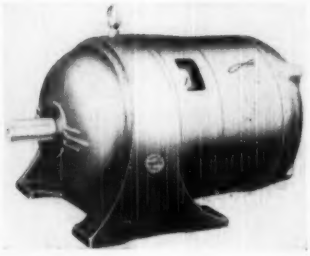
Steam-size coal feeds direct from the coal bunker by a metering worm to a transfer housing. Here it meets a stream of air mixed with furnace gases and moves in the air stream to the furnace and the grates. Preheated fines burn in suspension, reducing cinder carry over.
Iron Fireman Mfg Co, 3170 W 106th St, Cleveland 11, Ohio.





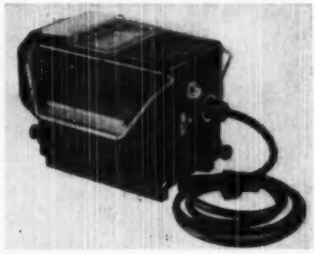
STATIONARY FIREFIGHTER P424

Centrally located steel tank, containing dry chemical and nitrogen cylinders (for pressurizing the tank), acts as stationary firefighter for wide-area plants, such as gasoline-storage areas, large chemical plants, etc. Units come in 500-, 1000- and 2000-lb capacities, and supply dry chemical up to 450 lb per min through underground piping to hose stations.
Ansul Chemical Co, Marinette, Wis.



GEARMOTORS P468

Built in 17 sizes they provide single, double and triple reduction units for speed from 780 to 7.5 rpm. Motor ratings of 1 to 75 hp are available for practically any industrial application. Conventional open, dripproof, splashproof, totally-enclosed and explosionproof motor constructions can be had for either ac or dc.
Foote Bros Gear & Machine Corp, 4545 Western Blvd, Chicago, Ill.



INSULATION TESTER P457

In this rectifier-operated megohmmeter, the hand generator is replaced by a power-pack consisting of a constant-voltage stepup transformer and selenium rectifier. Instrument is suitable for measuring insulation resistance of control circuits and general power equipment.
James G Biddle Co, 1316 Arch St, Philadelphia 7, Pa.

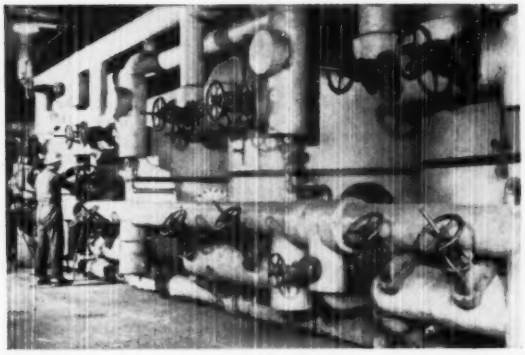
(*Continued on page* 190)

For further data on above items use reply cards on page 198a, identifying your request with letter P and number

DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS

Filters cleaned in 7 hours



by Dowell Service

Quick, effective cleaning of industrial filters and filter beds now possible with Dowell Service

Three coal filters in a municipal power plant had been in use for three years. Although back washed weekly they were almost plugged with carbonate scale. *In less than seven hours,* Dowell Service restored the units to a high degree of efficiency. For most industrial filters and filter beds, as well as all types of heat exchange equipment, Dowell Service is the best answer for fast, economical cleaning.

Special solvents, selected to fit the particular scale problem, are pumped into the equipment utilizing existing connections. When the troublesome scale is dissolved or disintegrated, the spent solution is removed. The unit is then flushed out and put back into operation. No dismantling or modification of equipment is required—costly down time is minimized.

Dowell Service has been proved best in hundreds of cleaning operations. Skilled engineers, specialized equipment, and step by step control make Dowell the logical answer to your cleaning problem.

Call on Dowell for your next scale removal job. There is a Dowell office near you. Ask for a free cost estimate now.

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Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

A SERVICE ORGANIZATION

. . . So I Wrote Them a Letter

► INSTRUCTION BOOKS have always been close to my heart. Over the years I've read a lot of them.

Every new piece of equipment we get in the plant carries with it an instruction book. This piece of literature is supposed to tell you everything about your new purchase—what it is, how it works, and what to do if it doesn't work. Many times it does tell what you want to know.

But too often I've been tempted to think the writer of a particular handbook was afraid I really would find out what his machine was all about—he threw so many obstacles in the path of my learning what I wanted to know.

Only the other day I learned how we engineers could do something to bring these handbooks into line with our needs.

It all started with a document that came with the new electronic control I requisitioned for our plant.

The first page said here was a pamphlet designed to introduce any man, with a fair knowledge of practical electricity, to electronics so he would be able to understand, operate and maintain this equipment.

I started reading.

After a glance at a "simplified" schematic diagram and two paragraphs of mighty big words, I was yelling for my assistant. His kid was a radio ham, so I asked him to take the booklet home to the boy and find out how the darn thing worked.

Next day he came back with the booklet—and the kid. The booklet was pretty tough going, the kid said. Could he take a look at the control?

He sat down and sketched out the circuit right from the apparatus. Then he compared his sketch with the schematic diagram in the book and showed us why we couldn't make head or tail of the instructions. Some of the most important parts of the circuit had been so "simplified" as to be meaningless; others had been left out.

Yet the manufacturer of what turned out to be a good product expected us to be able to operate the unit efficiently by reading an incomplete and hard-to-understand handbook.

I got so mad I sent the kid's sketch to the manufacturer together with the schematic, cut out of the handbook, plus a few 4-letter words of my own.

Not long after, I got a very apologetic letter from the sales manager of the company. He seemed genuinely thankful that I'd gone to the trouble of showing him how to improve the handbook.

That gave me a new insight. After all, manufacturers really want their products understood—and above all used correctly. It's essential to good will. But sometimes they don't ring the bell.

Maybe the men who write the handbooks are too close to the design end of the product. Maybe they don't realize what it's like out in the plant trying to read what they've written. Maybe they assume we know more about their products than we do and so leave out information we need badly.

But if we engineers write to these boys and tell them how we like our instruction books written—in simple words with clear illustrations telling exactly how the equipment works and how to operate and maintain it—well, maybe we'll get better instruction books once the writers realize how they can fall short of these goals.

The important thing is to write the manufacturer. It's the only way he can learn that his instruction book is off base. You tell him and he'll do something about it.

George Edwards

Engineer

ASSURE STEAM-TIGHT RINGS

Engines give full power, greater economy with Texaco steam cylinder oils

Texaco makes *a complete line* of steam cylinder oils. This means you can get the one you need to keep engines running smoothly . . . regardless of whether they are oldtimers or mere youngsters in service.

Aside from your special requirements, you will find that all Texaco steam cylinder oils have these basic advantages: they atomize thoroughly and properly . . . cling to cylinder walls to guard against wear and to keep rings steam-tight . . . stop "groans" and reduce maintenance costs.

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FOR EVERY OPERATING CONDITION

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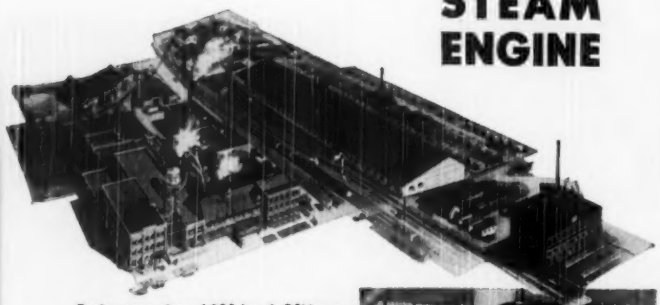
MAKERS OF FAMOUS

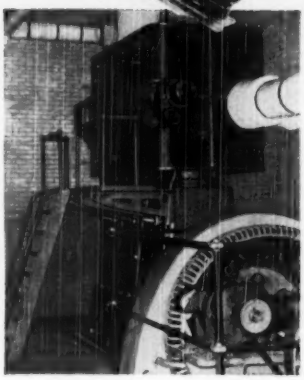
HOLGATE TOYS

GENERATE THEIR OWN POWER WITH A

SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINE



Engine room view of 800-kw, A-C Skinner Vertical "Universal Unaflow" Steam Engine at Holgate Brothers Company.



"Old as the Nation." In 1789, the year which saw George Washington take office as first President of the United States—Holgate Brothers Company, Kane, Pennsylvania, was established. Through its entire history, Holgate has devoted its production to and has been a leader in the woodworking field. This 161 year old manufacturer is today best known for Holgate Toys—famous among child educators, parents and children.

An 800-kw. Skinner vertical "Universal Unaflow" steam engine-generator unit has been recently installed in the Holgate plant to supply electric power, with exhaust steam being used for heating and processing. Still in daily operation are two Skinner steam engines, one installed more than 20 years ago. The installation of the new engine is testimony that "a repeat order is the best evidence of satisfaction."

Investigate the Skinner way of generating electric power, or of driving compressors, blowers, refrigeration and air conditioning equipment in your plant, hotel or institution. Catalogs and detailed information are available on request.

For Over 80 Years, Doing One Thing Well—Building Steam Engines

SKINNER ENGINE COMPANY, ERIE, PA.

ELECTRONICS

(*Continued from page* 128)

one end of the measuring chamber is focused by a curved mirror and lens onto a thermopile at its other end. Radiation from the lamp passes constantly to the thermopile (series of thermocouples) and falls on it in inverse proportion to the smoke density through which it passes. Voltage generated by the light rays heating the thermopile is measured continuously by a potentiometer-type standard indicating-and-recording pyrometer, calibrated 0 to 100% smoke density.

Indicating recorder can be round or a strip chart, and equipped to operate signals, usually a set of lamps. Each lamp is a different color to represent one of five progressive smoke densities—0 to 20, 20 to 40, 40 to 60, 60 to 80, and 80 to 100%. When density is below 20% one lamp lights, between 20 and 40% two lamps light, and so on, until at densities above 80% all five light.

To keep lamp and thermopile lenses clean, the two entering stack gas streams flow toward the center return tube, and away from the chamber's ends. Additional cleaning is obtained by streams of air that enter through small holes just in front of the lamp and thermopile lenses.

Recorder has a sensitive electrical balance in which voltage of the thermopile is balanced against an adjustable voltage and is measured in terms of this working standard. At the time of measurement the forces are in balance. No current flows. Thus measurement of thermopile voltage is independent of other factors, such as a change in resistance, caused by temperature changes along the wires connecting thermopile to recorder.

Bolometer Smoke Detector. Smoke-density indicator and recorder, Fig. 3, uses a bolometer that receives and measures radiation from a light source. In this system a light source is a 150-watt sealed beam spotlight on one side of breeching or stack. It is focused on a bolometer detector element on the opposite side of stack or breeching. Alignment of light source and detector is assured by mounting them on opposite ends of a 4-in. slotted pipe. Slot in the pipe is 3 in. wide and up to 5 ft long. Air infiltration carries dust away from the lenses to keep them clean.

Bolometer has a tungsten filament, which with a reflector is sealed in a vacuum. This filament, which is the smoke-density detecting element is responsive to the total radiation reaching it from the light source. This radiation is focused by a parabolic reflector on the tungsten filament. Temperature of the filament, and thus its resistance, varies with the radiation received. This

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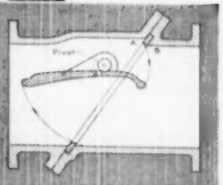
TILTING DISC

Check Valves

Because of their unique design, Chapman Tilting Disc Check Valves *close without slamming*. There is no water-hammer . . . no vibration of pipe lines or adjacent structure. Nor any danger of opening up pipe joints or rupturing pipe lines. All mighty important reasons why maintenance costs are bound to go down when you standardize on this valve with the cushioned closing.

Yet that's only part of the story. Chapman Check Valves also reduce head losses 65% to 85% over conventional type check valves. And, when installed on pump discharge lines, they not only make possible increased pipe-line capacity but also effect substantial power savings.

Why not send for bulletin with engineering data *today*?



Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

THE CHAPMAN VALVE MANUFACTURING COMPANY

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RUBBERLOKT ROTARY WIRE BRUSHES • SCREEN CLOTH • SKIP HOISTS • STACKERS
TRANSMISSION BELTING • VIBRATING CONVEYORS, FEEDERS AND SCREENS

is a measure of smoke density and is recorded by an electronic recorder.

Fig. 4 is a simplified diagram of the smoke detector and the measuring circuits. The latter use an ac potentiometer circuit that operates on the null-balance principle. A 115-v ac supply powers the light source, which is a standard sealed-beam spotlight with a 10-ohm resistor R in series to insure long life. Detector and measuring circuit are supplied at 7.5 v through stepdown transformer P. This voltage is further stepped down through isolating transformer I to supply a reference voltage across slide-wire resistor S.

When transformer P has the polarity shown, current flows through isolating transformer I, the null adjustment, range adjustment and slidewire resistor S, as arrowheads indicate. Current also flows through the bolometer and the temperature compensator. A connection from between the bolometer and temperature compensator to the amplifier and motor recorder applies a potential to the grid of the first-stage amplifying tube. A circuit for this potential is from the grid to the tube's cathode, through part of slidewire S and the null adjustment N to + on transformer P. This potential is balanced by one from the contact on N, through the top part of S and the amplifier to between the temperature compensator and bolometer to + on transformer P. When these voltages are in balance the contact on S and the recorder pen are at rest. When this condition exists voltage drop across the bolometer is balanced against voltage drop across upper portion of slidewire S.

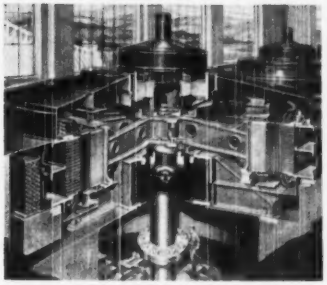
Recording Smoke Density. If smoke becomes denser, less light reaches the bolometer, and its temperature and resistance decreases. This decreases voltage drop across the bolometer and increases it across the temperature compensator to increase the potential on the grid of the first-stage tube. The measuring circuit is now out of balance, which is corrected by motor M starting and moving the contact upward on S to cut out some of this resistance. When the measuring-circuit potentials are in balance again, the motor stops and the recorder pen is positioned to show smoke density.

If stack gas becomes clear, more light reaches the bolometer, and its temperature and resistance increase. Potential on the amplifier grid is reduced, and the measuring circuit is again out of balance.

This time to obtain a balance, motor M reverses and moves the contact down on S until potentials are again in balance. At this point the motor stops, with recorder pen positioned to show haze density.

Null adjustment calibrates for max-

First Choice for U.S. Turbines!



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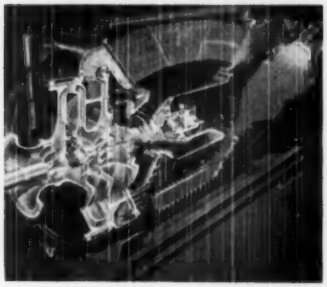

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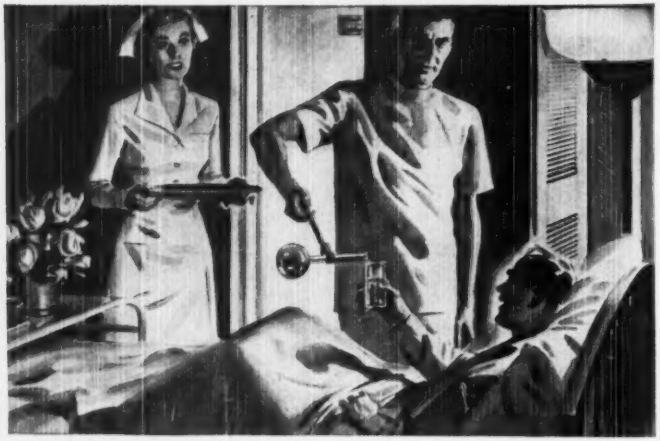

Radioisotopes were needed by a Boston hospital for patient treatment. Lead-shielded box of radioactive iodine (weight, 35 lbs.) picked up by Air Express in Knoxville, Tenn., at 11 A.M., delivered 7:15 P.M. Charge, $8.60. Hospitals, like all business, use Air Express regularly to get supplies from anywhere in hours.

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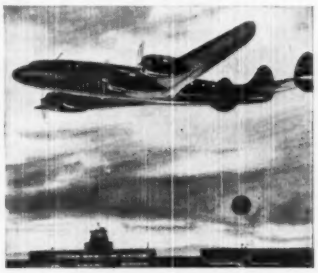

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imum smoke density, a condition that can be produced by turning off the light. By use of the range adjustment the recorder is calibrated to minimum density. Resistance of fixed resistor X depends on distance between light source and smoke detector.

When we study electronic-recorder circuits a detailed description of this recorder circuit will be given. When writing this article, the author freely consulted literature of the Diamond Power Specialty Corp, Ess Instrument Co, F W Dwyer Mfg Co, Leeds & Northrup Co and Bailey Meter Co.

Next article will study circuits of phototube electronic smoke detectors and recorders.

TECHNICAL BRIEFS

(*Continued from page* 140)

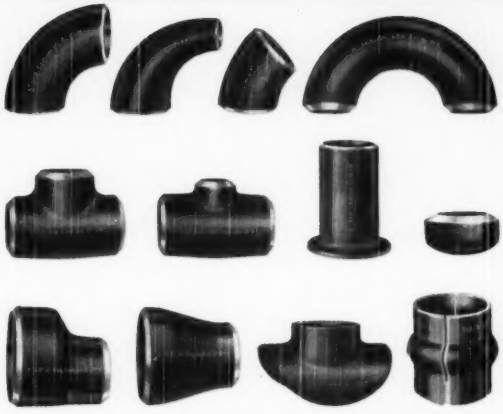
story since this type of amplifier requires a definite voltage change on the input grid for full output and this voltage change, rather than the almost infinitesimal power, determines the design of the input circuit.

Both amplidyne and amplistat, on the other hand, require only a given power change on the input. It is possible to wind the excitation coils to take this power either at high voltage and low current, or at low voltage and high current. Either the amplidyne or amplistat input coils may be wound to match the impedance of the driving source to utilize full advantage of power gain.

Vacuum-tube amplifiers, however, operate from an error signal source capable of supplying considerable current. But very little voltage change is incapable of taking advantage of the current-supplying ability of the input. Under these conditions it gives no more output than if the input circuit were only capable of supplying microamperes. Thus, the extremely high power gain of the tube amplifier is realized only with high-impedance input circuits, such as that from photoelectric tubes. But it is incapable of using with similar efficiency the possible output of a millivolt shunt.

Magnetic input to both amplidyne and amplistat cannot be designed only to use the power available from low-voltage input sources. But they do have the properties of electrically isolating input from the output circuit, which is not possible in a simple dc electronic amplifier. They also permit, under certain conditions, the addition or subtraction of several electrical signals still maintaining electrical isolation. *AIEE Paper No. 50-32.*

RECTIFIER EQUIPMENT FOR ELECTRONIC DC MOTOR DRIVES, *by M J Mulhern and S N Crawford, General Electric Co.* A functional description is given of an



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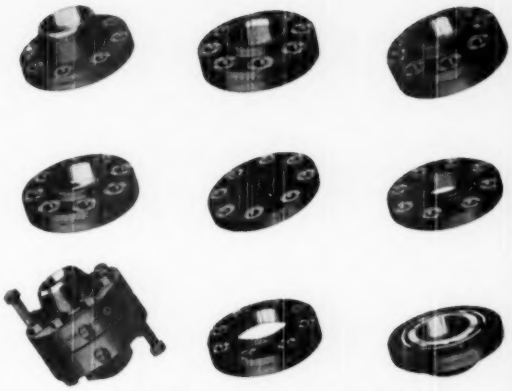
Standard through Double Extra Strong



FORGED STEEL FLANGES

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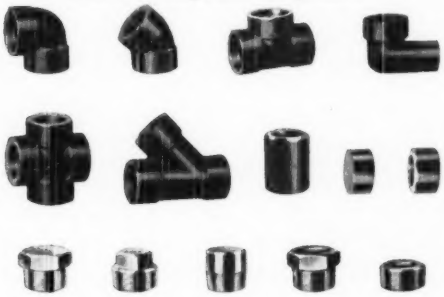
150 lbs. through 2500 lbs. pressure

FORGED STEEL FITTINGS

Screwed and Socket Welding

⅛-inch through 4 inches

2000 lbs. through 6000 lbs. pressure



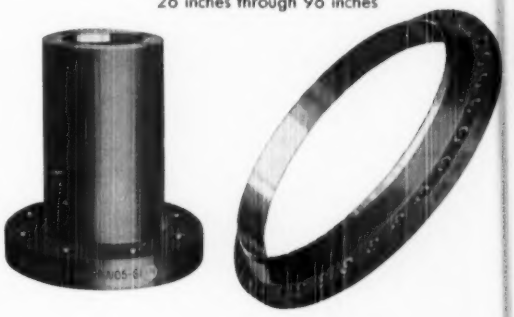
TO MARK PROGRESS

LONG WELDING NECKS

1-inch through 24 inches

LARGE O.D. FLANGES

26 inches through 96 inches



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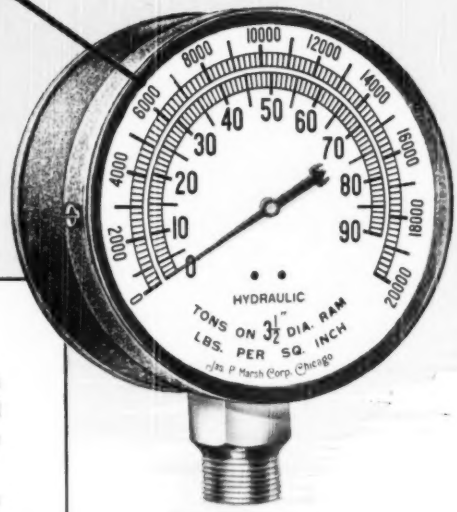

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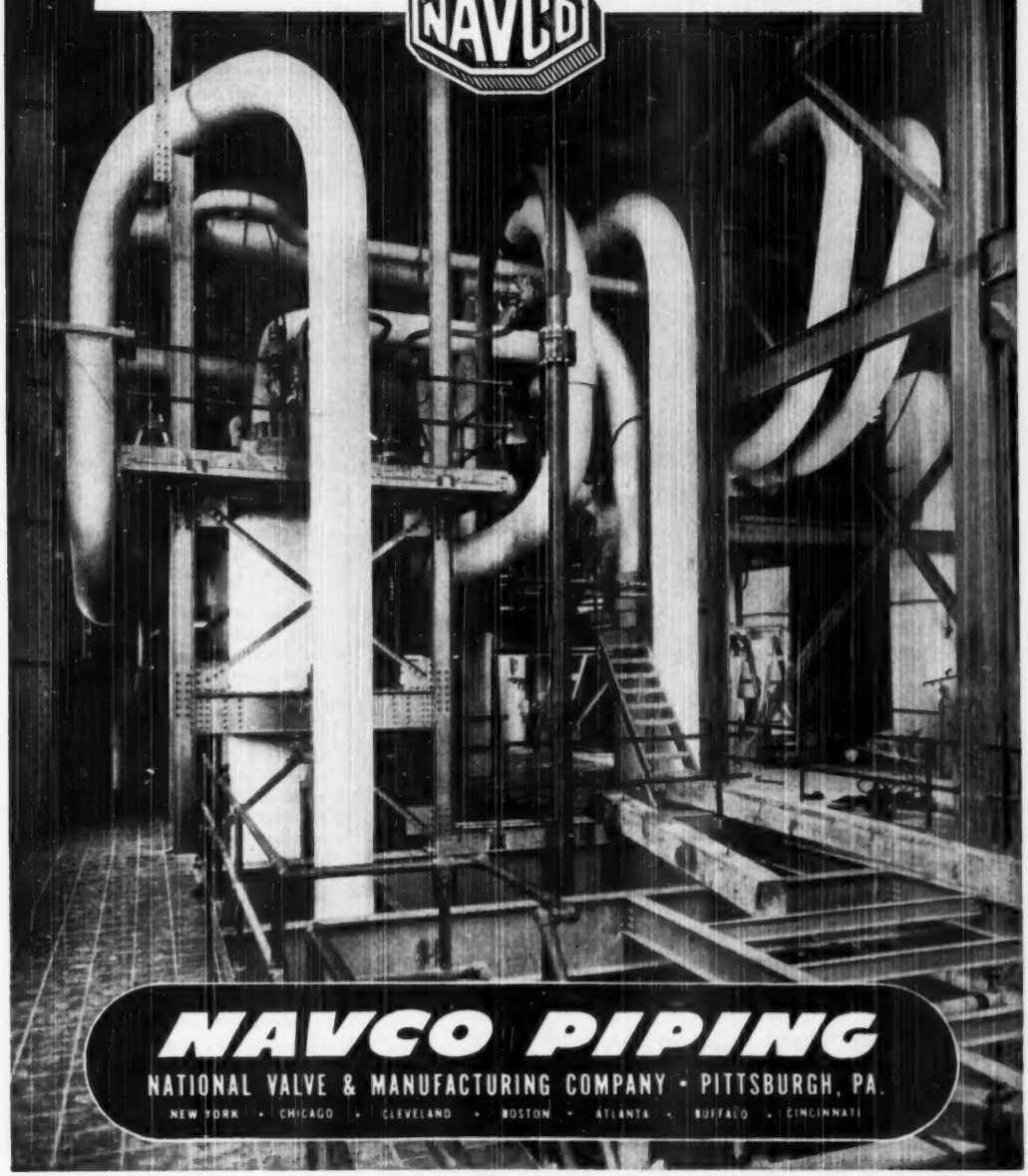

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MAMARONECK, N. Y.

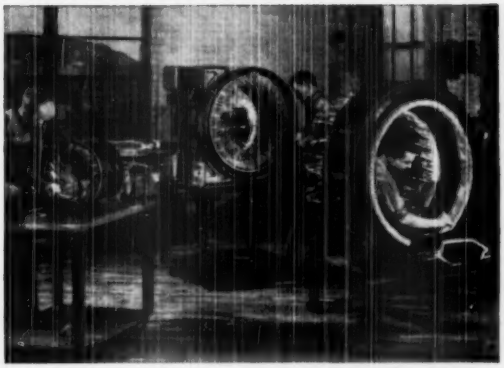
adjustable-voltage rectifier equipment, which delivers moderate power and is suitable for the control of one or more dc motors. These rectifiers incorporate high-gain amplifiers and excitation circuits, which have a high degree of reliability and freedom from frequent maintenance. A well-regulated output voltage is obtained by the use of the amplistat circuit. Output voltage may be continuously adjusted in response to several systems as required. The assembly is made compact and economical by full utilization of the cubicle space. These features make possible a package unit rectifier equipment, which meets all the service requirements of industrial applications requiring regulated variable-voltage source.

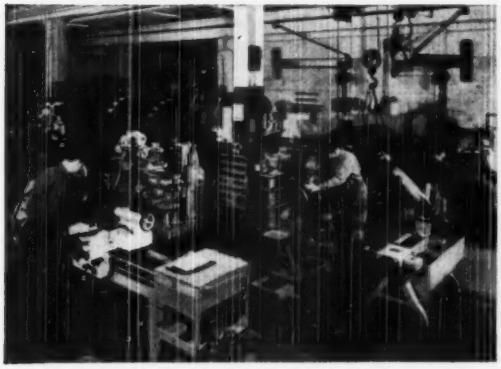
Rectifiers have proved successful in supplying dc power to all types of applications, street railways, mining, steel mills, electro-chemical and general industrial. Use of rectifiers for dc motor control is a natural development because of their ease of control, high speed of response, and use of all static components. Economic studies made for dc drives indicate that 500-v dc gave the best returns, and, accordingly, standards have been made at this voltage. A 3-phase double-way rectifier will deliver 550-v dc, when supplied from a 460-v 3-phase system. This is a standard-distribution voltage, and standard transformers are available, thus eliminating the added cost for special transformers. *AIEE Paper No. 50-33.*

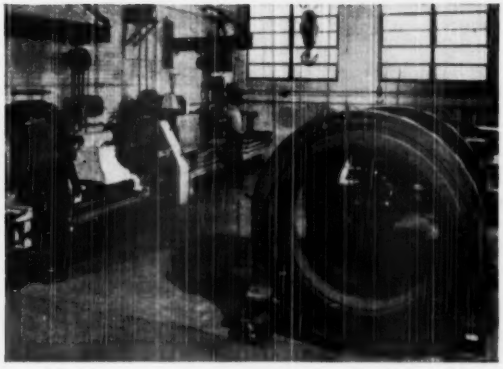
BUS TRANSFER TESTS ON 2300-VOLT STATION AUXILIARY SYSTEMS, *by A A Johnson, Westinghouse Electric Corp, and H A Thompson, Duquesne Light Co, Pittsburgh, Pa.* Aim in the series of tests outlined is simply to determine the optimum time interval between opening one circuit breaker and closing the other for a bus transfer. It is difficult to determine this interval except by actual test since an induction motor when disconnected from its source continues to generate a voltage. The period required for this voltage to decrease to zero varies, depending on size, speed and load on the motor. Authors outline the details of each test made, along with oscillograms illustrating the actual bus transfer in each test.

Optimum transfer time is about 50 cycles for the auxiliary system in question. This transfer time assures greater mechanical safety to the motor windings than if the transfer interval were shorter. Where transfers were made in about 10 to 15 cycles, abnormally high motor currents would flow. Reason is that residual voltage on the bus is still about 75% normal and about 180 deg out of phase with the new bus voltage. *AIEE paper No. 50-59.*

(*Continued on page* 168)







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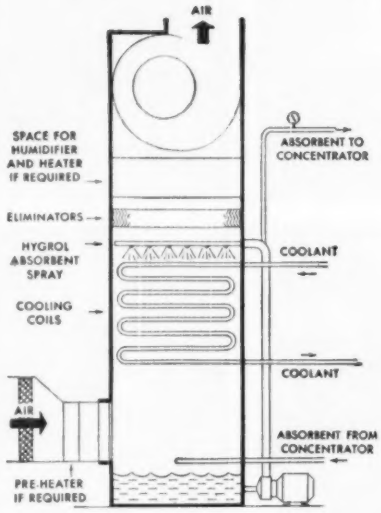
Niagara "Controlled Humidity Method" Uses Hygrol, Hygienic Liquid Absorbent

● The Niagara "Controlled Humidity Method" is a new system of air conditioning giving complete control of temperature and relative humidity, holding constant conditions or varying them at the will of the user. Especially, it provides dry air at normal atmospheric temperatures with little or no refrigeration required. A condition of 15 grains of moisture per pound of air at 85 deg. F. dry bulb temperature has been produced without refrigeration.

The apparatus is enclosed in a casing thru which the air is drawn by fans. The air is filtered and then enters a chamber where it is dehumidified in passing thru a spray of "Hygrol" Liquid (a hygienic hygroscopic chemical that absorbs the air-borne moisture and contains no salts or solids to precipitate) In the same chamber are located cooling coils which remove the latent heat of evaporation and also sensible heat as required.

The absorbent liquid spray falls into a tank at the base, where it is piped to a concentrator, removing moisture taken from the air. The re-concentrated liquid returns to the system. This process is continuous, and the apparatus operates at full capacity at all times.



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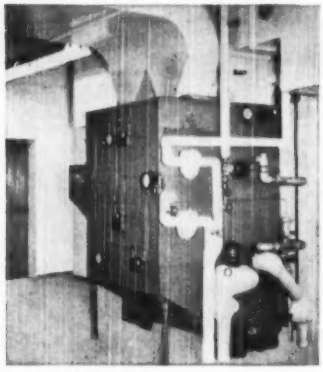
The same equipment may be used to provide winter air conditioning when required, by installing a tempering coil at the outdoor intake, an humidifier, and a reheat coil above the eliminators.

This equipment is manufactured in a range of sizes providing from 1000 to 20,000 CFM of conditioned air from a single unit, and mutiple unit installations are practical. It is expected that, by reducing the need for refrigeration, the cost of air conditioning will be reduced by this method. Applications generally are in a temperature range from 35 deg. F. upward. Below the freezing temperature of water, the Niagara "No-Frost" method is applicable.

The equipment is protected by U. S. and foreign patents. Installations have been made in food and chemical process industries, in packaging hygroscopic products, for preventing condensation of moisture on metals and other products in storage, in air conditioning for laboratory control and for human comfort.



For further information, write Niagara Blower Company, Dept. **P, 405** Lexington Ave., New York 17, N. Y.

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AUDIBLE NOISE OF POWER TRANSFORMERS, *by T D Gordy, General Electric Co, Pittsfield, Mass.* Magnetostriction means a change of dimensions of our magnetic material under magnetic stimulus. But there are other noise sources.

On that keynote the author steps out to cover the other sources, such as resonant parts or structures, vibrations at core joints and gaps, vibrations caused by interaction between core and coil, and vibrations of the coil conductor-carrying current. All these may result in noise generation or transmission.

After a rather complete coverage of the subject the author concludes that characteristics of power audio noise vary with individual design. The more important characteristics, such as variations with excitation, voltage, load, frequencies present and transformer size, are fairly well established. For special installations, low-noise-level transformers may be designed and built. But they are costly. Alternative is building an enclosure around transformers — but that, too, is expensive and has its own disadvantages. Hence an economic evaluation is always in order. *AIEE paper No. 50-8.*

COMPRESSED AIR

(*Continued from page* 103)

Results of duplicate experiments with carbon *C* heated in air, Fig. 5, show there was a noticeable change in direction of the heating curves at about 220 C and definite indication of exothermic reaction at 250 C. At temperatures above 250, exothermic reaction proceeded rapidly, as shown by the sharp reversal in the curve's direction.

A sample of carbon *B* was heated in a stream of nitrogen rather than air, all other conditions being the same. Results are shown in Fig. 6 by a solid line whose shape indicates that in an inert atmosphere exothermic reactions did not occur. For comparison, the dotted curve added to this figure represents typical performance of carbon *B* when heated in air. Contrast in the shape of the two curves shows definitely that reactions of exothermic nature are caused primarily by oxidation of the carbon.

Temperature Limit. Practical significance of the temperature of 250 C (482 F), found to be the point of incidence of measurable exothermic reaction of the carbons tested, is illustrated by Fig. 7, where this temperature is shown in relation to the calculated temperatures of adiabatic, single-stage compression with different compression pressures and intake-air temperatures. (It is generally considered that the actual compression temperature in any one stage is only slightly less than the theoretical temperature of adiabatic compression.)

Compression temperature developed

Serving

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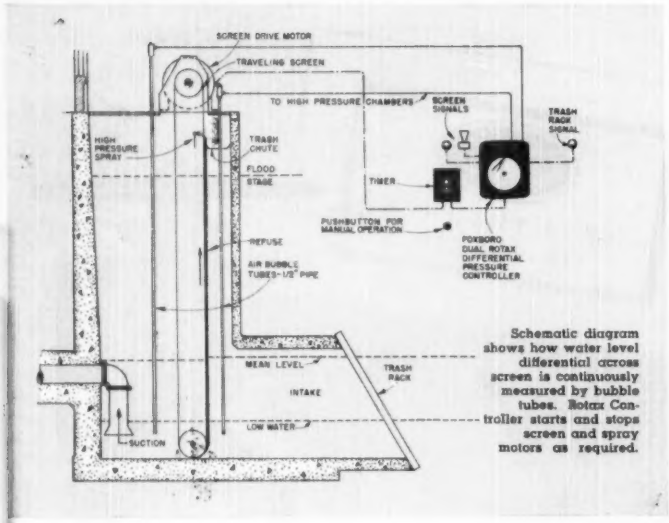

Schematic diagram shows how water level differential across screen is continuously measured by bubble tubes. Rotax Controller starts and stops screen and spray motors as required.

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Make sure your intake suction well can't go dry when excessive refuse suddenly piles up on the traveling intake screen!

The Foxboro Traveling Screen Control System automatically starts the screen-rotating motor and the cleansing spray whenever refuse accumulation causes the water level difference between opposite sides of the screen to exceed a certain preset value. Quickly, it purges the screen of refuse and restores the intake level to normal —or sounds an alarm indicating that the cleaning mechanism is unable to cope with the difficulty. What's more, this action takes place only when the screen actually becomes clogged . . . no waste of power or unnecessary wear on mechanism through needless periodic operation.

The Foxboro Traveling Screen Control System is easy to install, inexpensive to operate, and pays big dividends in better intake operation, less maintenance and greater peace of mind. Write for complete information. **The Foxboro Company, 68 Neponset Avenue, Foxboro, Mass., U.S.A.**

ROTAX Liquid Level Controller. The heart of the system, translates level differential into operation of motors. In addition, it can operate warning horn or light in case of unusually severe fouling. Circular or rectangular case models.

FOXBORO INSTRUMENTATION
REG. U.S. PAT. OFF.

by a single-stage compressor operating at 100-psi gage pressure with 60-F intake air is just at the point of incidence of exothermic reaction of the carbon deposits studied. The same condition would exist, Fig. 7, at lower compression pressures and higher intake-air temperatures.

Investigation of several compressed-air-system explosions showed all compressors were 2-stage, of the same design, and were being used under rather adverse conditions regarding continuity of operation. Before modification of the intercoolers (which had been done to reduce operating temperature in the hope of preventing further explosions), temperature of the air at the discharge of the second stage had been found as 490 F, which is remarkably close to the 482 F observed experimentally as the point of incidence of exothermic reaction of carbon deposits.

Complex Decomposition. The apparatus was also used to determine temperature at which carbon monoxide occurred when carbon was heated in air. Both carbon dioxide and carbon monoxide are liberated when the carbon-oxygen complex is decomposed by heat, but as an analytical method of high sensitivity was available for determining carbon monoxide, the incidence of carbon monoxide alone was taken as indicating the beginning of decomposition of the complex.

Carbon Monoxide. A fresh sample of carbon (2.3 grams) was used for each experiment, and the combustion tube was maintained for four hours at a constant temperature by a thermocouple and temperature controller.

Results of a series of experiments conducted in the described manner with carbon *C* are given in Table III, on which each point represents an individual experiment. Under the described test conditions, carbon monoxide was detectable in the atmosphere of the closed system after the carbon had been heated to 100 C but could not be detected as a result of heating to 60. This indicated that the incidence temperature of decomposition of the carbon-oxygen complex lay somewhere between 60 and 100 C. This is in agreement with the findings of Jones and Townend, who state that the complex with coal starts to decompose at 70 C.

Results indicate that the decomposition rate of the complex bears an exponential relationship to temperature, and it may be noted that this rate (as indicated by concentration of carbon monoxide) increased tenfold for each increase of 50 C.

Appreciable consumption of oxygen by the carbon was evident when the material was heated to 150 C, Table III. These results provide a more accurate indication of the incidence of oxygen

Paris gets 215,000 more kw's; KELLOGG provides all critical power piping!

ALONG with the need for rebuilding and expanding Europe's industrial capacity, there is a corollary need for more efficient power production, calling for higher operating temperatures and pressures. As these conditions approach and exceed 1,000°F. and 1,700 p.s.i., piping naturally becomes a major problem, demanding the most modern techniques for satisfactory solution.

For example, piping layouts for the two new 100,000 KW main turbines now installed at Gennevilliers Station were first checked on Kellogg's exclusive apparatus for determination of stresses under operating conditions.

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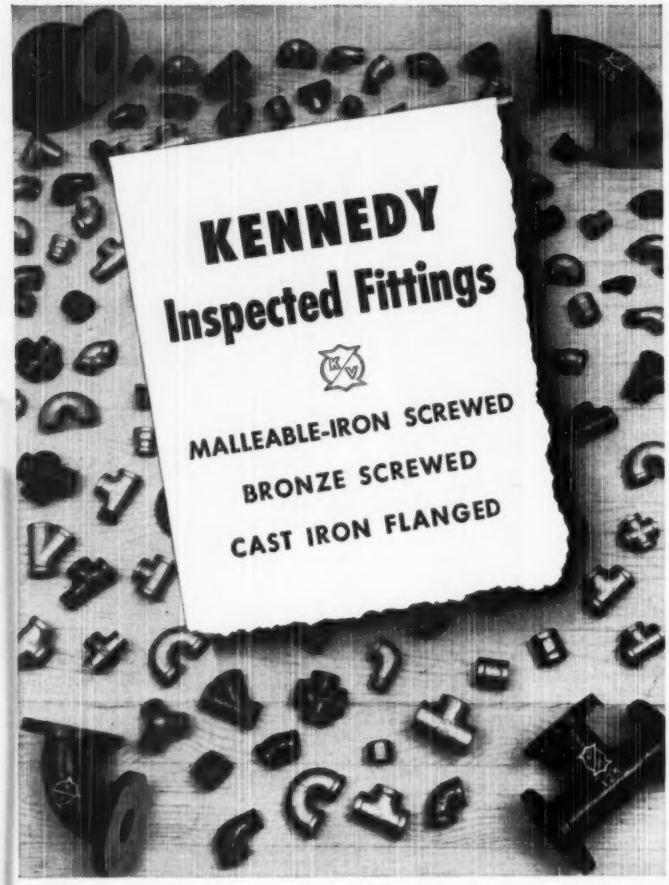

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consumption by the carbon than was obtained in preliminary experiments previously described. As oxidation reactions that occur in the formation of the complex are exothermic, observation of the minimum temperature at which oxygen consumption takes place may provide the most sensitive and accurate means of determining the incidence of such exothermic reactions.

Period of heating at each temperature (four hours) was selected arbitrarily. It probably did not represent sufficient duration of heating to cause complete breakdown of the complex existing on the carbon sample nor exhaustion of the reactivity of the carbon with oxygen. The carbon sample that had been heated to the highest temperature, 230 C, was given two additional 4-hour heatings at that temperature. It was found to produce carbon dioxide and carbon monoxide, and to consume oxygen during both intervals.

PLANT PROBLEMS

(*Continued from page* 136)

capacity to handle air leakages into the system.

First, check steam pressure at the ejector steam chest when operating at the increased generator load, to be certain pressure is at no time less than the minimum for which unit is designed. If ejector is designed to operate on saturated steam, it requires slightly higher steam pressures with superheated steam.

Then find pressure in the intercondenser. If this exceeds 8 or 9 in. absolute, there are excessive noncondensables or there is insufficient cooling water circulating through the intercondenser. No mention has been made of whether raw water or condensate is used in the intercondenser.

Another thing to look out for is the building up of the condensate level in the hotwell and bottom of main condenser, thus restricting the flow area to the off-take. Also, if intercondenser drains to main condenser through a trap or gooseneck drain, intercondenser should be elevated enough to drain by gravity. Thus it would drain even when the first stage is not operating and the inter-stage pressure is practically equal to pressure in main condenser.

W GRAF JR *New York, N. Y.*

Look for Two Causes

LM's VACUUM DROP could be caused by excessive air in steam, not enough cooling water, or a leaky shell. Dirty tubes and faulty air pump are ruled out since vacuum loss is progressive during generator loading.

Excessive air in steam has little ef-

(Partial view of the enormous new lubricating oil plant at Lake Charles, La., where this great new oil is processed.)

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This new oil—the best known to science... gives you a cleaner engine... more economy ...minimum carbon residue.

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New Premium Koolmotor is made by the unique "Heart-Cut" Process which retains only the choicest part of the finest crudes. *It's so superior that in recent engine tests it outscored nine other major premium motor oils.* No wonder Premium Koolmotor is better in every way! Cleans better, seals better, cools better and fights acid, sludge and corrosion far more effectively. Switch to this remarkable new oil today.

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fect on vacuum at low loads. But as load increases, so does steam flow. Since condenser pressure follows Dalton's law, partial air pressure at high loads increases, causing condenser vacuum to drop. Best solution is a deaerating feedwater heater. If one is in use, *LM* should check its operation carefully. In addition, if he makes frequent starts with a cold boiler, he should be careful that it is thoroughly purged of air before being put on the line.

Insufficient cooling water also causes vacuum to drop as load increases because exhaust steam is not condensed fast enough. If pump speed can be increased, this may bring vacuum back to proper value.

At low turbine loads the air pump can usually handle moderate condenser-shell leaks. But as steam flow to condenser increases, air-pump capacity is not large enough to handle air and gases from steam and leakage air. Vacuum drops as a result. *LM* can test for air leakage by closing the valve between condenser and air pump ten minutes. Rapid loss of vacuum, indicated by the gage, shows there are leaks in the shell. The well-known flame test usually locates these leaks satisfactorily.

Vacuum losses of the magnitude he describes are seldom encountered without an obvious cause. Since a single cause is not evident, two or more must be at work during turbine operation. Rough calculations show change in throttle-steam conditions could not cause the vacuum loss.

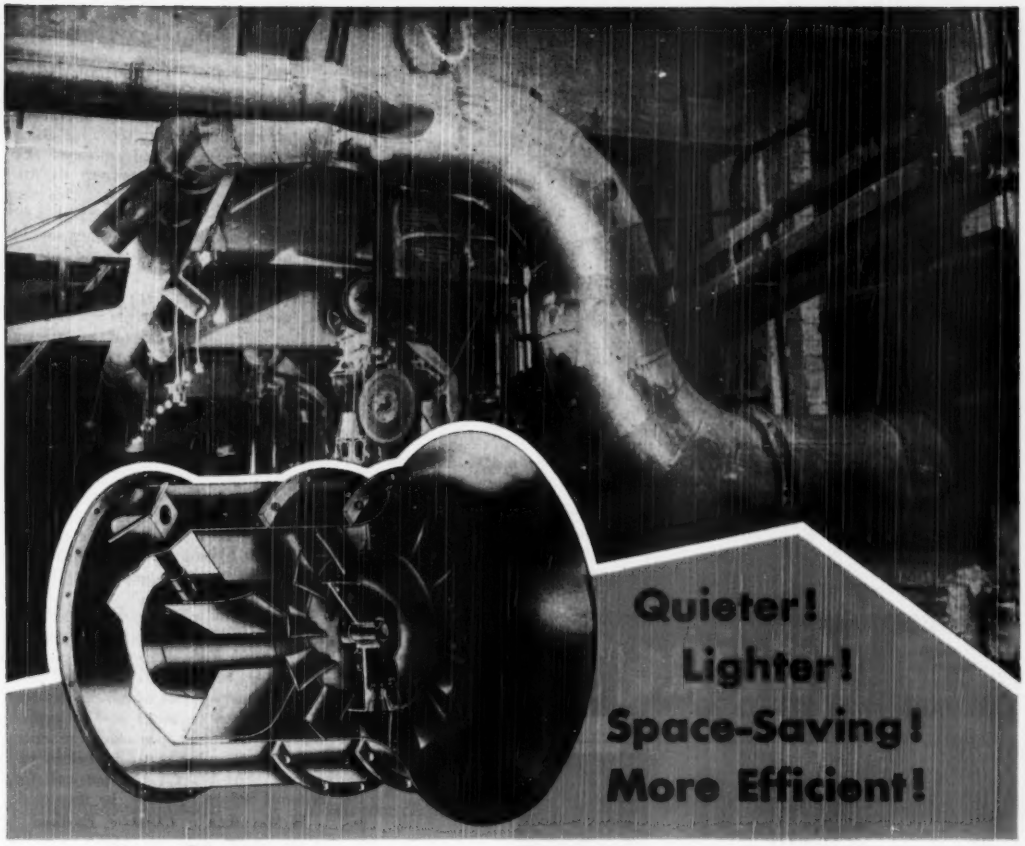
TYLER G HICKS *Summit, N. Y.*

Condenser May Be Dirty

GUARANTEED WATER RATE for LM's machine should be about 12.5 lb per kwhr. Assuming backpressure of 2 in. Hg, with 10,000-kw load, steam load on the condenser would be $10{,}000 \times 12.5 \times 1035 = 129{,}300{,}000$ Btu/hr. With 14,000 gpm, or 7,000,000 lb/hr, of circulating water, temperature rise should be $129{,}300{,}000 \div 7{,}000{,}000$, or 18.5 F. This is not excessive. But if temperature rise with 10,000 kw or less exceeds this figure there is less than 14,000 gpm of circulating water flowing through the condenser.

This condenser is large enough for the job as it has about 110 sq ft of condensing surface per 1000 lb of steam per hr. This should be sufficient to obtain a backpressure between 2- and 2.5-in. Hg with a 20-F rise in circulating-water temperature.

If exhaust-steam temperature exceeds circulating-water outlet temperature by more than 10 F, the condenser is dirty. The greater the difference, the dirtier the condenser. All the above



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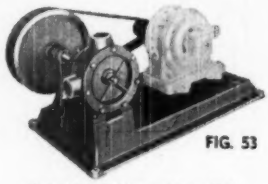

FIG. 53

Quiet V-Belt Motor Driven Unit

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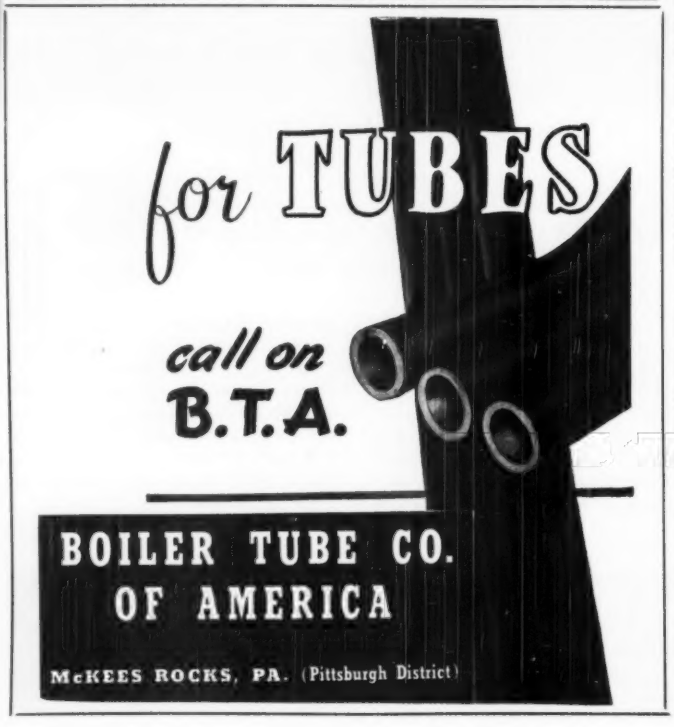


can be determined by referring to the log sheets or by taking a few temperature readings.

I suspect that his condenser is air-bound either on the steam or water side, or both. Waterboxes should be vented at the top after the circulating-water pump is started to expel any entrapped air. Next, measure air discharged from the air pump. This can be done with an orifice in a pipe cap. Leakage for this size condenser should not exceed 6.5 cfm. He should inspect air-pump connections inside the condenser to see if they are open and taking air from the right place; namely, taking air out, instead of taking steam out and leaving air in.

E W McKNIGHT *Greenville, N. C.*

Weir Will Verify Flow

I ASSUME *LM's* vacuum trouble developed after a history of satisfactory running. Since correct vacuum is obtained at low loads, trouble is probably not due to air leaks or the air ejector. Trouble is almost certainly on the circulating-water side, and most likely fouled condenser tubes.

If *LM* finds his tubes clean, let him take a look at his circulating-water system. If dirty screens, valves not fully open, mussel growth, or damaged pump runners do not reveal the answer, make a check on water flow by orifice plate as weir. This is sound practice and might be easier to do before examining any other parts that call for removal before they can be inspected.

W MELVILLE *Cheshire, England*

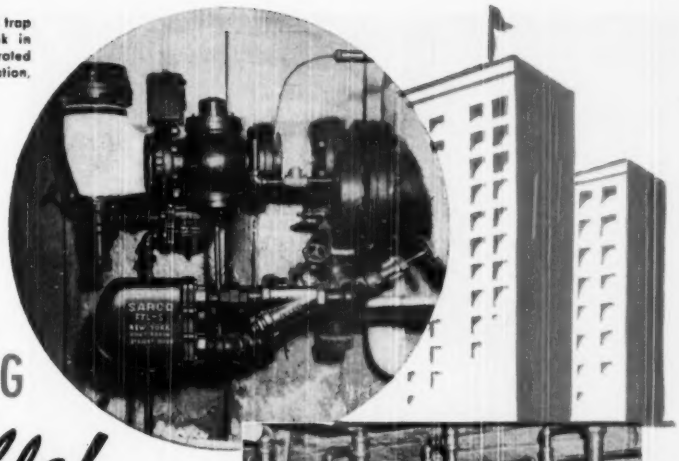
General Outline to Follow

GOOD PERFORMANCE in a condenser depends on tightness, cleanliness, circulating-water supply and design. A simple heat balance, based on circulating-water temperature rise, shows the heat given up in the condenser.

Trouble could be caused by turbine diaphragm leaks, bad or scaled blading, or any condition that reduces turbine efficiency. Poor turbine efficiency has a tendency to feed high quality or superheated steam to the condenser at high loads.

If trouble persists after the above points are investigated and the equipment is found in first-class shape, the difficulty should be due to air leakage or insufficient ejector capacity. Data on vacuum at low loads indicate leakage is not excessive and ejector capacity is sufficient. To check this, meter the air discharge. This should increase only slightly with load. If air increases, there may be a leak in the system that thermal expansion or vibration causes. That is, increased temperature or vibration may be opening a joint or crack.

Sarco TR-21 control and Float trap on 1300 gallon storage tank in the Equitable Building, operated by The Real Estate Corporation, Chicago.



HOW SARCO KEEPS A BIG OFFICE BUILDING *Comfortable!*

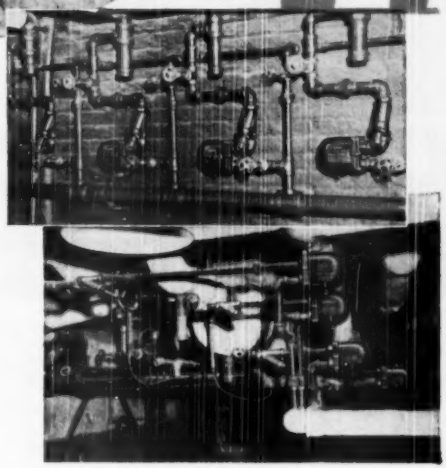
Few office workers realize what goes on below the street level in order that they may work in comfort and without interruption.

But the engineer can tell you that Sarco is the heart of the heating and air conditioning systems in this big building. In fact, he says he "wouldn't have anything else."

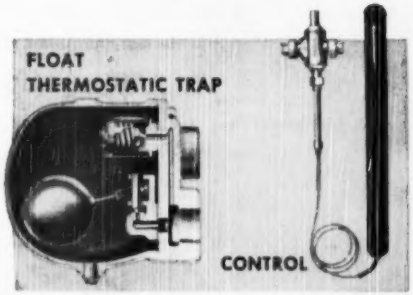
Hot water service, the source of many tenant complaints, is controlled to a degree with Sarco TR-21 regulators, float traps and strainers on primary and secondary tanks—including one for air conditioning. (See illustrations)

A bank of risers is dripped by Sarco float traps and of course Sarco radiator traps are found on every radiator.

Engineered primarily for service, such a system also results in minimum fuel consumption.



Bank of Sarco FTLO traps on risers and TR-21's on storage tank and heater



YOU CAN HAVE THIS SERVICE TOO . . .

It sounds simple, and yet hundreds of buildings are still handicapped by impossible heating hookups; noisy radiators, some areas too hot, others too cold, hot water complaints all day long, and a fuel bill that is 10 to 20% higher than it should be.

The Sarco Representative near you will look over your building without obligation. You will be surprised to see how much can be done and how little it will cost.

SARCO SAVES STEAM

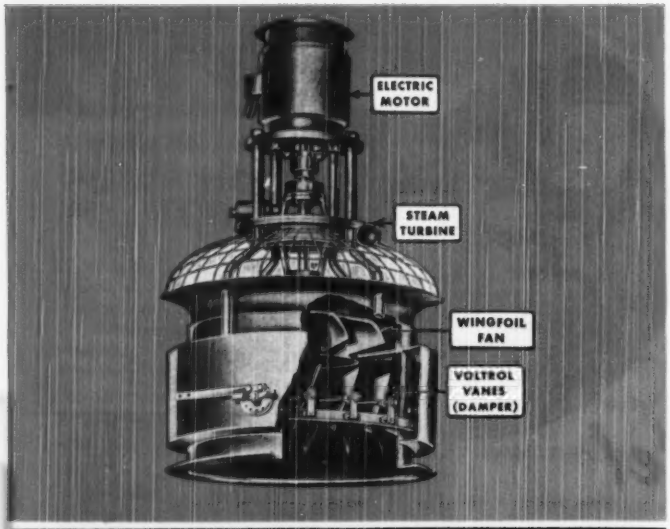
SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT



New Wing Forced Draft Blower Incorporates both turbine and electric drive in one unit

With the new Wing Dual Drive Forced Draft Blower you can alternate between turbine and electric drive. Your choice of drive may be governed by consideration of heat balance, of economical operating cost, or by an emergency affecting the source of power. All you have to do is throw a switch to operate the motor or turn a couple of valves to change to turbine drive! There is no harm to either motor or turbine when one or the other is idle. A wide range of control is possible in both motor or turbine drive. Throttling gives adequate control with turbine drive and the Wing Voltrol Vanes (capacity regulating dampers) permit capacity regulation when constant speed motor is driving. Automatic operation may be arranged with combustion-control system. The unit is extremely compact and may be adapted to either vertical or horizontal discharge. Installation is simple, easy and economical. It is shipped completely assembled and aligned, ready to bolt to the foundation.

Write today for further details

L. J. Wing Mfg. Co.

Executive Offices and Factory: 50 Vreeland Mills Road, Linden, N. J.

Canadian Factory: Montreal, Canada

Wing

DUAL-DRIVE BLOWERS

Check the shaft sealing water. If this is condensate, a high load condition may be robbing the gland of its sealing water. Finally, check the steam supply. A leak in boiler feed-pump suction or other source of air may be injecting large volumes of air into the boiler. Besides pitting the boiler, this air will leave with steam, and overload the air ejector at high load rates.

W BADGER *Granville, Ohio*

Tube Cleanliness a Factor

LM SHOULD MAKE complete condenser test with turbine carrying light and full load. First, measure amount of cooling water being circulated, as well as temperature going into and out of condenser. Then check amount and temperature of condensate. If he wants to make a really accurate test, measure temperature of steam leaving the last stage of turbine. It may be three or four deg higher than condensate. The heat-transfer coefficient of the condenser tubes material can be found in any handbook.

From this data and the condenser's physical dimensions *LM* should be able to obtain what is called the cleanliness factor. This is the ratio of heat transferred in actual condenser to heat transferred in a 100% efficient condenser. This factor should be 85% or higher for a condenser in good condition.

C PENIZA *Ensenada, Puerto Rico*

Might Be Blade Deposits

LM's PLANT MUST BE in a fairly high altitude as indicated by 25.5 in. barometric pressure. He probably takes the condenser water from a river or lake. Many rivers carry some sand along with the water. This erodes pump runners, causing insufficient flow of condensing water and loss of capacity in the condenser.

Power, Oct. 28, 1924, carried an article on Fort Dodge Gas and Electric's then new plant. I worked on the design and building of this plant. Boiler pressure 235 psi and temperature 556 F. The 3000-kw unit had 2½ sq ft per kw or 7500-sq-ft single-pass condenser served by one 4000- and one 10,000-gpm condenser pumps. Condensing water was taken from the Des Moines River. By comparison, this would indicate the unit in question does not have enough condenser or pump capacity for 10,000 kw with like steam conditions.

Best way to check this is to obtain from the manufacturer the turbine water-rate curve. Helpful condenser data should include weight of steam per hour it will condense with inlet water at the highest temperature in summer. The condenser pump data

I'M A TWO-HANDED CATCHER!

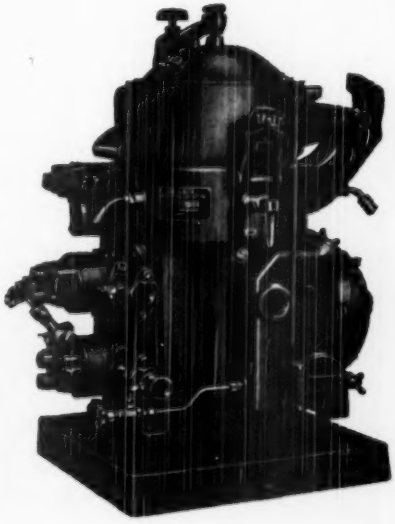
"I am De Laval Centrifugal Force, and when I go to work to remove impurities from lubricating oil, I get rid of ***both*** contaminants — ***dirt*** and ***water.*** My centrifugal force throws out every drop of water, which is continuously discharged to waste. Simultaneously I throw out any ***solid*** impurities which are collected in the dirt holding space of the bowl of the centrifuge but out of the way of the oil being purified.

"It makes no difference whether I am asked to purify turbine oil or Diesel oil. Whenever I am on the job, the power plant engineer can be confident that his power plant is protected from trouble at all times.

"I am also tops at dehydrating and cleaning Diesel fuel oil. When used for this purpose I enable the operator to get the maximum BTU value from every gallon of fuel oil."

Bulletin TO 1-12 gives you further details. Write for it.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited Peterborough, Ont.



DE LAVAL
Lubricating Oil Purifiers

for small drainage jobs . . .

A NEW *SMALL* TRAP WITH *BIG* TRAP QUALITY FEATURES!

TEST
STRONG
OUTLET
INLET
DRAIN
• Renewable seat—easily removed for servicing.
• Strong's patented, wear-resistant Anum-Melt† valve and seat—guaranteed leak-proof for one year. Scientifically designed Hi-Cap* orifice gives greater capacity.
• Oversized ports—increased capacity.
• Horizontal inline connections—simplifies piping.
• Stainless 18-8 high ratio leverage.
• Large gasket area.
• Seamless, deep drawn, stainless 18-8 bucket—no welds.
• Bottom drain or inlet connection.

Available for pressures from 0 to 150 p.s.i., the Strong* No. 070 fits all standard trap applications. Built especially for use on laundry, restaurant and hospital equipment and in industry wherever small drainage is a problem.

As with all Strong Semi-Steel Traps, the 070 is guaranteed against defects in material and workmanship for one year. Write today *for more complete information.*

*T. M. Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

† ANUM-MELT Reg. Trade Mark

will show whether the pump can meet the cooling-water demands for the condenser. Check the hp and speed of the condenser pumps.

Scale-forming material carried over from the boilers in the steam is one of the headaches in turbine operation. As deposit increases, steam demand per kwhr goes up until the turbine will not pull its load and the condenser will not maintain desired vacuum. Blade deposits may be removed by dissolving with a solution; solution required depends on the material deposited.

Every main turbine rates a flowmeter. Usually when something goes wrong with the unit, the steam rate for a given load goes up. In this case, a flowmeter might help locate the trouble and certainly would show many troubles developing.

S C PAGE *Buffalo, N. Y.*

Trouble-Shooting Guide

AIR LEAKAGE is the more probable cause of *LM's* trouble.

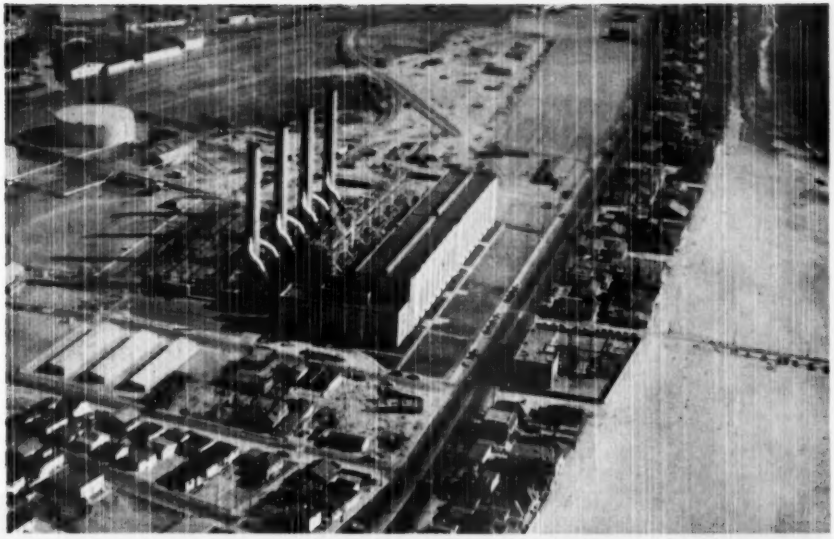
Thermal expansion of turbine casing while the load is increasing could force a gradually increasing air leak at an exhaust connection. *LM* should scan the accompanying trouble-shooting guide—he might get a worthwhile lead.

R A DENNING *New York, N. Y.*

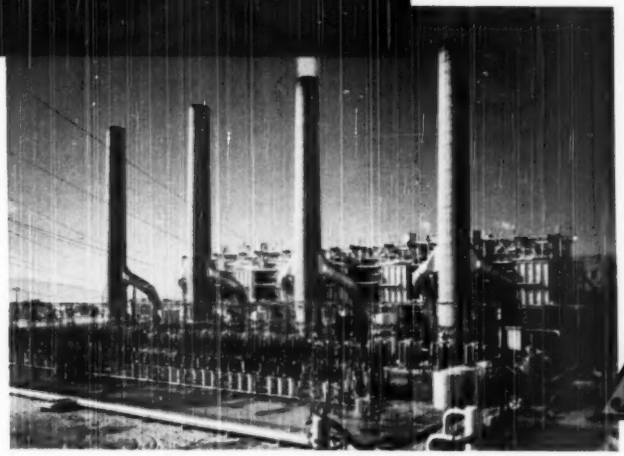
(*Continued on page* 184)

CAUSES OF POOR VACUUM

1. **POOR HEAT-TRANSFER CONDITIONS**
   - A. Circulating pump too slow
   - B. Clogged circulating-water system
   - C. High inlet-water temperature
   - D. Insufficient heat-transfer surface to carry the load
   - E. Water short-circuiting through waterbox partition between passes
   - F. Steam side of condenser greasy
   - G. Water side of condenser scaled or fouled
2. **FAULTY AIR-REMOVAL EQUIPMENT**
3. **AIR EJECTOR**
   - A. Insufficient cooling water
   - B. Steam nozzle plugged with scale
   - C. Steam pressure to ejector too low
   - D. High ejector-discharge pressure
   - E. Faulty drainage from intercondenser
4. **AIR LEAKING INTO CONDENSER**
   - A. Leaky gland packing
   - B. Air leaks into auxiliary exhaust line
   - C. Leaky exhaust-pipe connections
   - D. Leaky condenser joints
   - E. Open air valve or drain cock on condenser
   - F. Air carried over with steam because of:
     - a. Dissolved air in makeup feed
     - b. Exposed water surface in condensate system
     - c. Air trapped in boiler and main steam lines on starting up



HELPING TO MAKE THE WONDERS *of* SO. CALIFORNIA *more wonderful*



The 280,000 kw Redondo Steam Station was constructed to keep pace with the rapidly growing power demands of this region. Semi-outdoor design combines economy of construction with operating comfort and convenience and the entire structure has been built to resist the stress of possible earthquake shock. Unique is the provision for control of marine growth through thermal shock during periodic reversal of salt water flow in the two 2,000 foot intake and discharge tunnels which obtain condenser circulating water from the Pacific Ocean.

Stone & Webster Engineering Corporation designed and constructed the Redondo Steam Station for Southern California Edison Company.

STONE & WEBSTER ENGINEERING CORPORATION

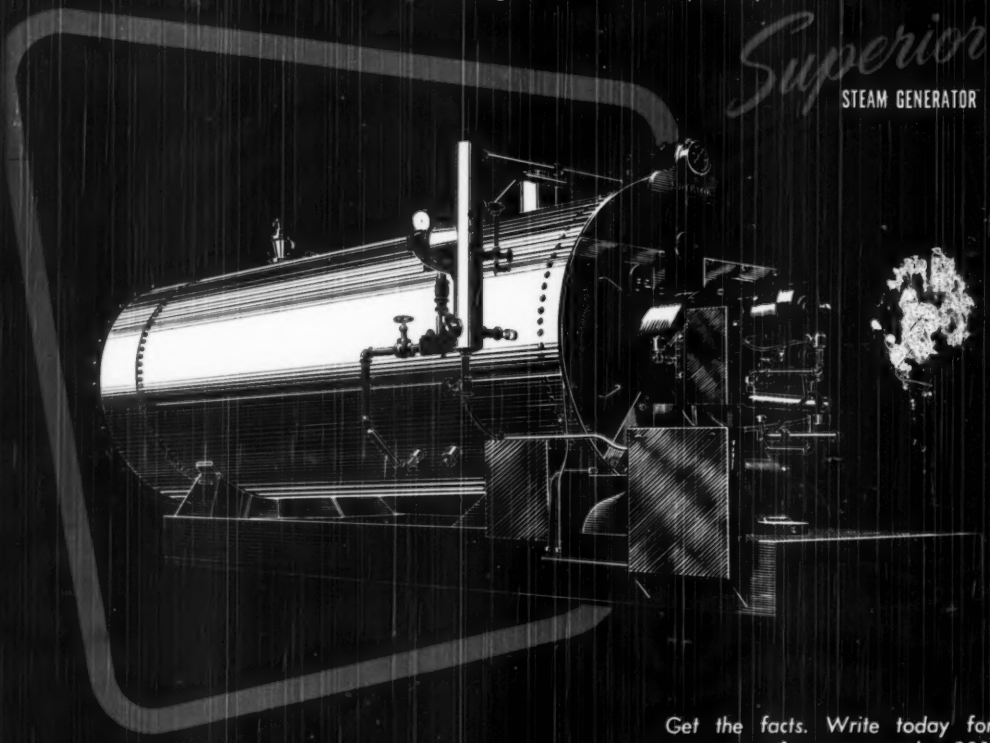
A SUBSIDIARY OF STONE & WEBSTER, INC.

FOR THOSE WHO DEMAND

Something More

. . . than ordinary steam generator performance, SUPERIOR Steam Generators provide the answer . . . and that "something more" is **more** rugged construction; **more** heating surface, **more** steam area, **more** weight per horsepower; **more** accurate control of fuel and air ratios; **more** dependable combustion equipment; **more** years of operation at peak efficiency . . . all of which adds up to 80% or more thermal efficiency which lasts, and lasts. For a steam generator is a long term investment with high dividends when you buy a . . .

Superior
STEAM GENERATOR

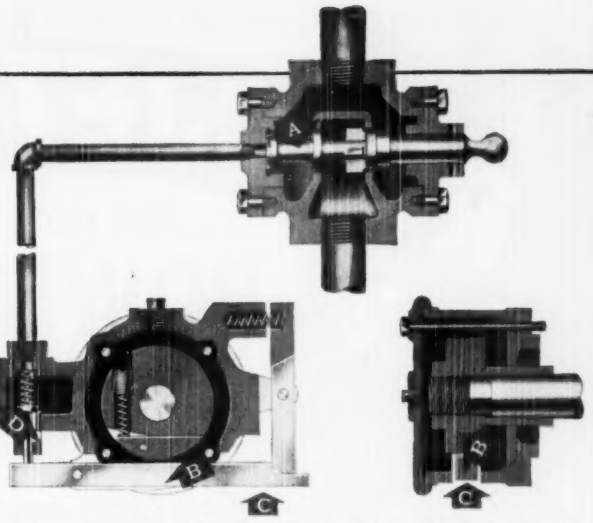


Get the facts. Write today for your copy of our new catalog 201.

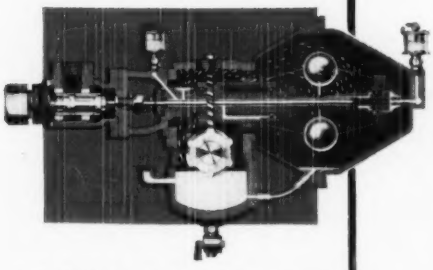
Superior Combustion Industries, inc.

Factory Emmaus, Pa.
Executive Offices Times Tower, Times Square, New York 18, N. Y.

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Speed Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When steam is turned on, pressure opens valve A fully. When excess speed is reached, centrifugal force throws weight B against lever C lifting pilot valve D. This releases pressure in back of valve A, closing this valve instantaneously, to shut off the steam. Safety trip can be tested easily while turbine is running by manually tripping and resetting lever C.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

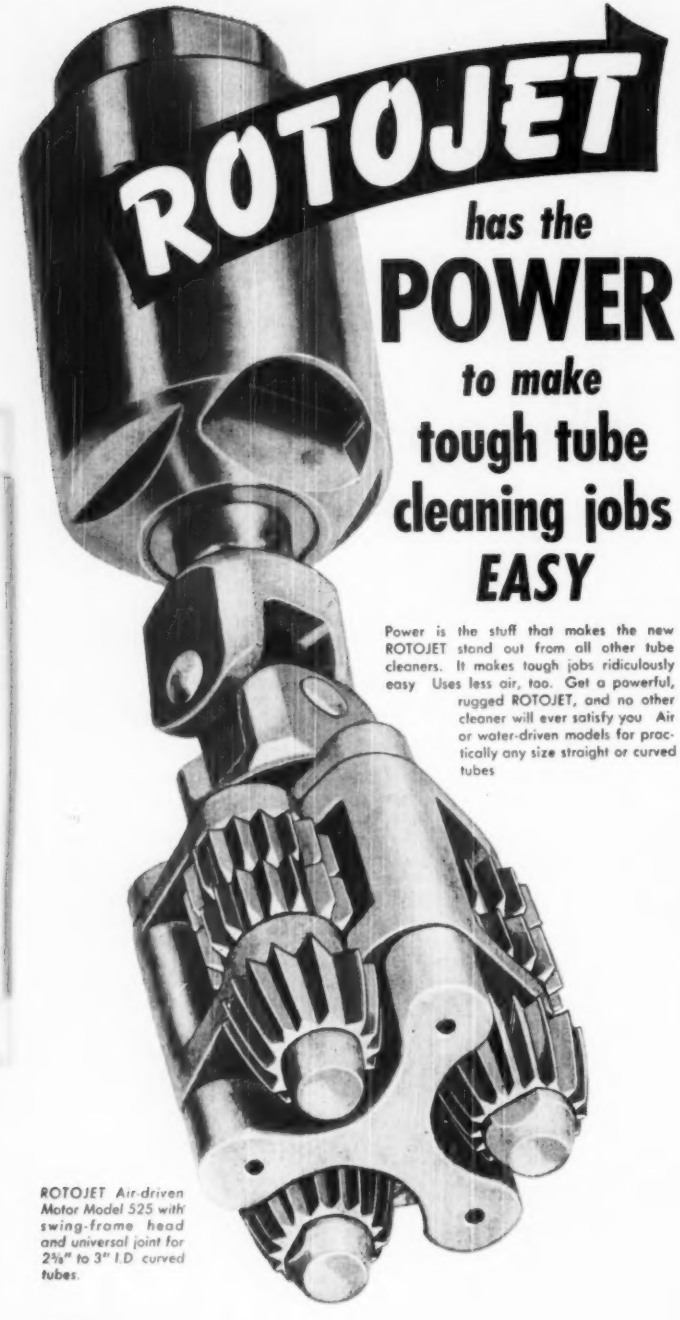
CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION, 164 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

COPPUS "BLUE RIBBON" TURBINES



Power is the stuff that makes the new ROTOJET stand out from all other tube cleaners. It makes tough jobs ridiculously easy Uses less air, too. Get a powerful, rugged ROTOJET, and no other cleaner will ever satisfy you Air or water-driven models for practically any size straight or curved tubes

ROTOJET Air-driven Motor Model 525 with swing-frame head and universal joint for 2⅝" to 3" I.D. curved tubes.

ELLIOTT COMPANY-ROTO DIVISION
153 Sussex Avenue Newark 1, N. J.

Check for GPM Needed

I ASSUME inlet cooling-water temperature for condenser is correct. High drop in vacuum indicates there is insufficient cooling-water flow. The condenser tubes are fouled.

Use following equation in checking condenser performance. Remember, cooling water removes about 950 Btu from each pound of steam condensed.

$G = 1.9\ W \div R$, where G is gpm of cooling water, W is lb per hr steam condensed, R cooling-water temperature rise in deg F.

With turbine carrying about 300 kw, value of W may be obtained from a flowmeter in condensate line. Value of R may be found by thermometer at inlet and outlet cooling-water nozzles on condenser.

If G is about 14,000 gpm or more, pump is producing enough cooling water and so the tubes are fouled. If G is much less than 14,000 gpm, pump and cooling-water circuit should be inspected to determine cause of insufficient capacity.

W H CHENAULT *Atlanta, Ga.*

CENTRAL STATIONS

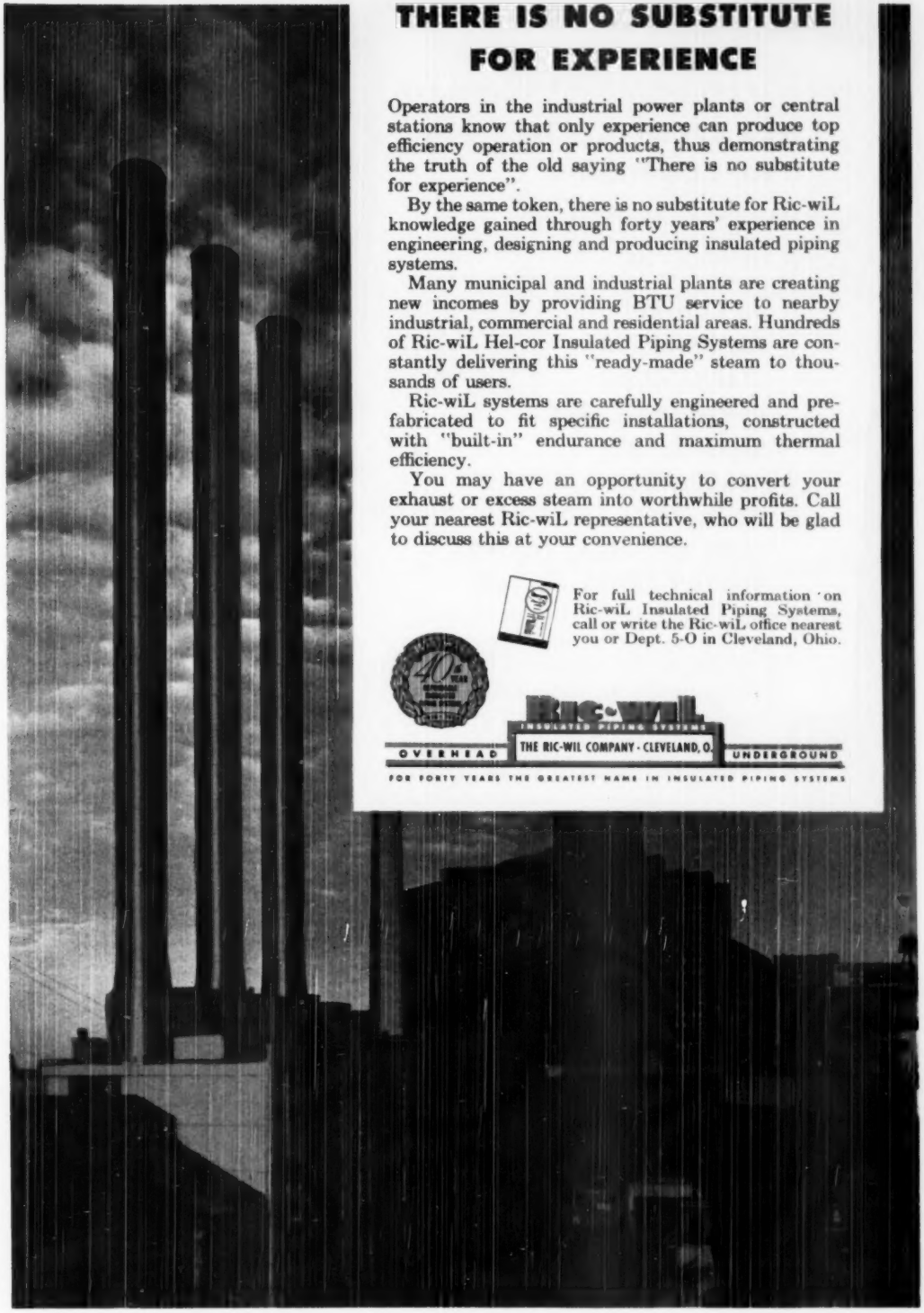
(Continued from page 97)

moval from dust-collector hoppers (4) supervising circulating-water screens and gates (5) station water and compressed-air services. Most of these have failure or trouble alarms, and some of the critical ones are called to the unit operators' attention.

Nearly every operating abnormality illustrates the value of closely coordinated unit operation. For example, when coal feed to mill fails, the electrical operator immediately knows it and adjusts output to keep steam pressure up. This causes load drops of 5 to 10 mw for a few minutes on two or three days a month during wet- and frozen-coal periods. Load drops from efficiency loss would probably be greater if steam pressure were allowed to decrease.

When the plant is operating on block loads and the load dispatcher calls for a change, the electrical operator announces what's to be done. The mechanical operator will advise him if the change should be made in any manner different from normal procedure. A quick change will be determined by ability to maintain water level, steam pressure, draft or whatever may be critical at the moment. If electrical trouble occurs, the mechanical operator knows at once its nature and what to do to restore order. The two operators watch each other's moves and, to some extent, each other's instruments.

A new station being built by Buffalo



THERE IS NO SUBSTITUTE FOR EXPERIENCE

Operators in the industrial power plants or central stations know that only experience can produce top efficiency operation or products, thus demonstrating the truth of the old saying "There is no substitute for experience".

By the same token, there is no substitute for Ric-wiL knowledge gained through forty years' experience in engineering, designing and producing insulated piping systems.

Many municipal and industrial plants are creating new incomes by providing BTU service to nearby industrial, commercial and residential areas. Hundreds of Ric-wiL Hel-cor Insulated Piping Systems are constantly delivering this "ready-made" steam to thousands of users.

Ric-wiL systems are carefully engineered and prefabricated to fit specific installations, constructed with "built-in" endurance and maximum thermal efficiency.

You may have an opportunity to convert your exhaust or excess steam into worthwhile profits. Call your nearest Ric-wiL representative, who will be glad to discuss this at your convenience.

For full technical information on Ric-wiL Insulated Piping Systems, call or write the Ric-wiL office nearest you or Dept. 5-O in Cleveland, Ohio.

40 YEARS

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INSULATED PIPING SYSTEMS

OVERHEAD THE RIC-WIL COMPANY · CLEVELAND, O. UNDERGROUND

FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

Here's the Equipment Which Will Give You
GREATEST EFFICIENCY and ECONOMY
in Metered Pressure Pumping of Chemicals for:

pH CONTROL
PRECIPITATION
STABILIZATION
CORROSION CONTROL
STERILIZATION
COAGULATION
ODOR, TASTE AND COLOR CONTROL
SLIME AND ALGAE CONTROL
DELIGNIFICATION CONTROL

- NO STUFFING BOX OR RUNNING SEAL
- HYDRAULICALLY-BALANCED DIAPHRAGM SEAL
- POSITIVE DISPLACEMENT PISTON MEASUREMENT
- FLOW RATE ADJUSTABLE WHILE IN OPERATION
- OIL-BATH LUBRICATION OF ALL MOVING PARTS
- UNITS AVAILABLE FOR MANUAL OR AUTOMATIC CONTROL

Lapp PULSAFEEDER
PISTON-DIAPHRAGM CHEMICAL PROPORTIONING PUMP
WRITE for Bulletin 262 with complete description and specifications.
LAPP INSULATOR CO., INC., PROCESS EQUIPMENT DIVISION, 275 MAPLE STREET, LE ROY, N. Y.

Niagara will have two reheat units. It will also have a centralized control room manned by unit operators. They will handle either the electrical or mechanical boards. This will simplify setting up shift schedules and give maximum manpower flexibility in times of trouble.

J M Drobelle: Central stations in the Midwest use turbines ranging from 7500 to 40,000 kw in capacity. Many modern installations are following the unit type of design which lends itself to centralized control. We have found in many of the older stations excess employes are needed because control positions are scattered all over the plant.

To keep investment down in central-control rooms all instruments were scrutinized carefully as to their real utility. By eliminating "gadgets" and recording instruments with records of doubtful value we save in both first cost and instrument maintenance cost. We have not found it possible to estimate the true cost of centralized control. Saving in operating-labor cost, however, has been very definite. Many of our new stations have an operating force of 19 to 21 men. These crews represent a saving of 25 to 50% in manpower over the needs of the older stations of equal capacity.

European Gas Turbines

(*Continued from page* 119)

turbine adiabatic efficiencies rather than by upping temperatures.

OTHER COUNTRIES

In France, there's quite some activity in the gas-turbine field. Most notable development is the SIGMA free-piston compressor and turbine. Compagnie Electromècanique in Paris is conducting tests in blade cooling by means of boundary-layer methods. Nothing new could be learned about the Mercier combined gas and steam equipressure plant.

In Holland, several engineering and ship-building firms have formed a common research and development company to study and produce gas turbines.

In Denmark, there is also a strong interest in marine gas turbines. Although no details could be obtained, there are signs of notable activity in Germany. Apparently they are continuing their work on ceramic materials for high-temperature gas turbines. On the whole Europe is extremely conscious of gas-turbine commercial possibilities.

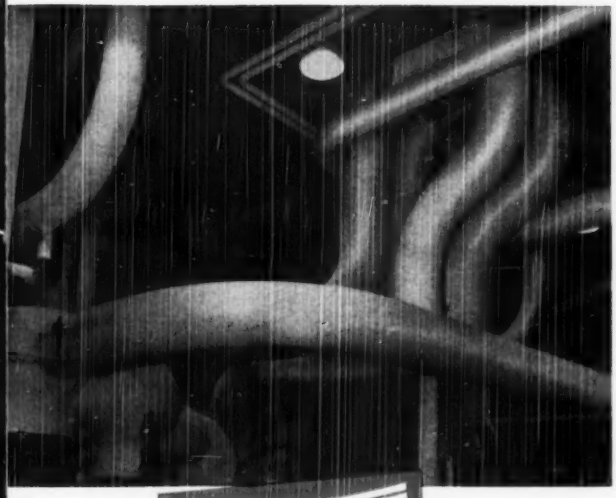
Public Service Electric and Gas Co placed its third 110,000-kw generating unit into service at the Sewaren Generating Station to bring total generating capacity up to 330,000 kw at this plant.

PIPING by MIDWEST

ANOTHER "First"

NEW SCHILLER STATION

First Complete Mercury-Unit Power Plant



The first installation of a mercury-unit power plant designed and built as a complete power generating unit . . . the Schiller Station of the Public Service Co. of New Hampshire at Portsmouth, N. H. is a notable achievement. When operating at designed rating of 40,000 kw and using Bunker C fuel oil, the heat rate is 9200 Btu per net kwhr.

The piping is by Midwest . . . fabricated and erected with undivided responsibility. "Firsts" are frequent with Midwest . . . have been throughout our more than four decades of experience with piping of all kinds. Midwest has grown up with modern high pressure and high temperature piping . . . through the years has achieved a wide reputation for better piping.

Whether you want a simple pipe bend, a series of complex prefabricated subassemblies, or a difficult piping job completely erected, Midwest has the facilities, the experience and the organization to meet every requirement. You will find it to your advantage to call upon Midwest whenever you need piping.

4 Plants are Better Than 1

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Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and South Boston • Sales Offices: New York 7—30 Church St. • Chicago 3—79 W. Monroe St. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—533 Maye Bldg. South Boston 27—426 First St.

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PIPING FABRICATORS AND CONTRACTORS

6 Big Reasons Why Engineers Prefer the

CAMPBELL
Boiler Feed Water Regulator

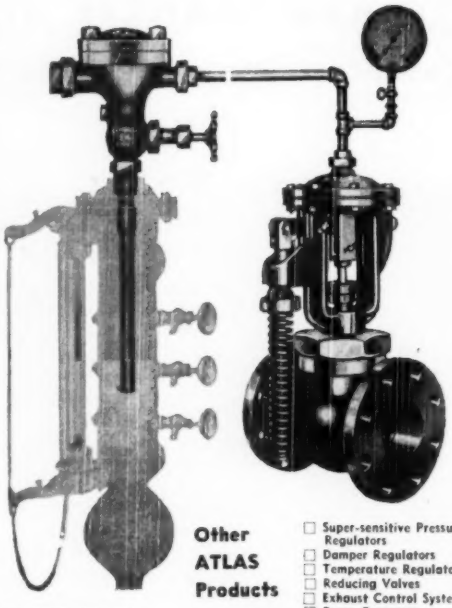
1—Continuous Blowdown.
2—No Moving Parts.
3—No Thermostats.
4—No Floats.
5—No Links.
6—No Generators.

Unquestionably, the CAMPBELL is the simplest of all boiler feed regulators. No trouble breeding parts. Easy to install, eliminating the need for "expert servicing".

This remarkable regulator, for many years, has been successfully controlling all types and sizes of boilers. The slightest change in water level instantly causes the regulator to operate the largest control valves — and with the utmost ease and accuracy.

Note the indicating gage — the only feed regulator that shows, on the control or switchboard, precisely what the regulator is doing at all times.

Rugged. Efficient. Economical. 50 to 400 lb. pressure, and up. Sizes 1" to 6". Guaranteed.



Other ATLAS Products

Check those on which you want complete data.

- ☐ Super-sensitive Pressure Regulators
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- ☐ Exhaust Control Systems
- ☐ Pump Governors
- ☐ Oil Control Cocks
- ☐ Humidity Controllers
- ☐ Thermostats
- ☐ Balanced Valves
- ☐ Control Valves

Ask for complete data. Also, check the other ATLAS products at the right. Mail to us with your name, address, and firm.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

289 SOUTH ST., NEWARK 5, N. J.
Represented in Principal Cities

New Gas Engine

(*Continued from page* 125)

on gas quality. Governor operates on a gas throttle valve, varying pressure in a gas header supplying fuel to the inlet valves. These are in the cylinder heads, operated from the camshaft by pushrods. Normally, three separate protective devices are installed to guard against: (1) overspeed, (2) lube-oil failure, and (3) excessive jacket-water temperature.

Performance. Need for daily full-load operation of the West Monroe engine has prevented testing at conditions other than full load and speed. On a 3-cylinder experimental unit, however, this design showed fast starting; even firing on all cylinders at no load; smooth running at low speeds down to one third of rated speed; overload capacities beyond normal field requirements, low exhaust temperatures at all loads, and good economy.

California-Oregon Expand Generation

The Oregon State Hydroelectric Commission has approved a license covering construction of two power dams on the North Umpqua River by the California Oregon Power Co. The dams will be located at Slide Creek and Soda Springs. A 40-mi transmission line will connect the project with the Dixonville substation at Roseburg.

Including the $6,000,000 Toketee unit, which was placed in service last summer, Copco's North Umpqua development will represent an investment of $14,390,000. The three plants are so arranged that waters of the North Umpqua, discharged at the Toketee plant, will be diverted to the Slide Creek unit and then on to the Soda Springs unit. Thus the same water will produce power at the three sites.

Rated capacity of the Slide Creek project will be 18,000 kw. It will consist of a reinforced concrete diversion dam located 1000 ft below the Toketee plant, and a concrete-lined canal and timber flume 2 miles long leading to the powerhouse. It is scheduled for completion in 1951.

Texas Eastern Transmission Corp asked the Federal Power Commission for authority to construct additional pipeline facilities, to serve utilities in the New England area as much as 200,000,000 cu ft of natural gas per day by 1951.

Installed rated capacity of Grand Coulee Dam power plant has been increased to 1,316,000 kw with the beginning of commercial operation by the twelfth 108,000-kw generator. Peaking capacity is about 1,500,000 kw. The generator was the third to be completed in the East power house last year. Three more of the same size are to be assembled this year and the final three in 1951.

WHEN YOU BUY A COAL CRUSHER

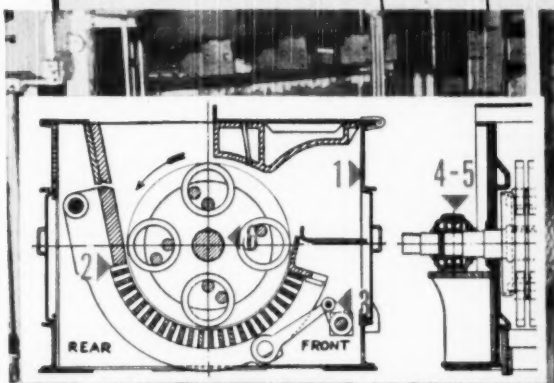
Important for Long Service, Low Maintenance, and Trouble-free Operation	Crusher Mfgr. and Type	
	"PENNA." RING-TYPE	Others
1 **Rolled Steel Frame:** Eliminates failures caused by hidden flaws in *cast* frames.	✓	
2 **Full Cage and Breaker Plate Adjustment:** Compensates for wear; operator gets maximum crushing life available in hammers and grate bars.	✓	
3 **Positive Cage Adjustment To or From Rotor:** Quickly, easily set with ratchet wrench—no chains or grappling hooks needed.	✓	
4 **Heaviest-duty, Anti-friction Roller Bearings:** Only *heaviest*-duty type assure long life; ask for sizes, then compare.	✓	
5 **Floating Bearing on Side Opposite Drive:** Absorbs shaft length variations caused by temperature changes, eliminating tremendous stresses and premature failures.	✓	
6 **Forged Steel Rotor Shaft:** The only construction assuring long service under severe operating conditions.	✓	

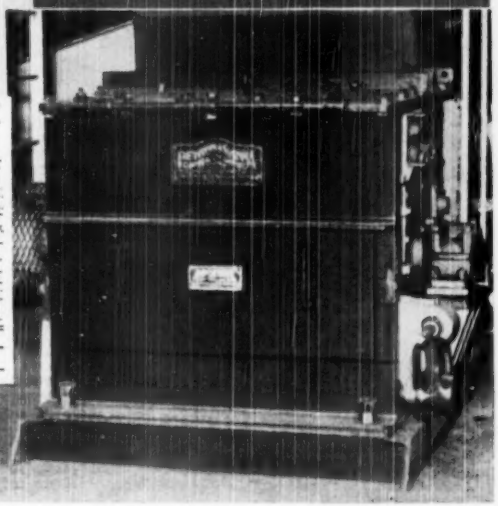
This *Check-off* List Can Help You Get Your Money's Worth

It's wise to remember that the purchase price of a crusher is only part of its final cost. Unless the type you select gives you long, trouble-free service at low maintenance, you may discover that the crusher with the lowest price tag soon eats up this price differential, and constant expense piles up month after month. To help you avoid such a predicament, we've checked some of the features to look for in the crushers you may be considering. Many operators who have been misled by first cost say, "For preparing pulverizer and stoker coals, Pennsylvania's your best buy in the long run." We'll gladly send you Bulletin 9001 containing additional details.

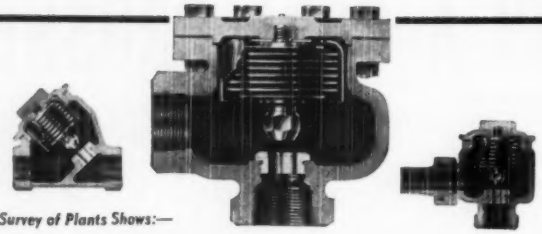
PENNSYLVANIA CRUSHER COMPANY, *Division of Bath Iron Works Corporation,* 1714 Liberty Trust Building, Philadelphia 7, Pennsylvania. Representatives in New York—Boston—Pittsburgh—Birmingham—Roanoke—Detroit—Chicago—St. Louis—Crosby, Minn.—Los Angeles—London, England.

PENNSYLVANIA
Ring-Type
GRANULATOR





PENNSYLVANIA CRUSHER COMPANY



Survey of Plants Shows:—

15 of 20 Engineers Prefer Nicholson Traps

To determine the best steam trap on which to standardize, a large processing firm recently asked their plant engineers for their preference. In 15 out of 20 plants the choice was Nicholson.

The repeated adoption of Nicholson steam traps in plants currently in big "cost-reduction-through-modernization" programs is another indication of their advanced features. To learn why an increasing number of leading plants are standardizing on Nicholson thermostatic steam traps send for our catalog. 5 types for every power, heat, process use; size ¼" to 2"; press. to 225 lbs.

Catalog 448 or see Sweet's

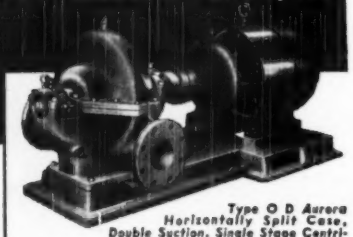
W. H. NICHOLSON & CO. 125 OREGON STREET WILKES-BARRE, PA.

INTEGRITY *Counts in* PUMPS, *too*

This Truly Great AURORA TYPE O D CENTRIFUGAL PUMP

for general water supply, for municipalities, industrial establishments.

also for handling condenser circulating water, wash water, liquids in paper mills and distilleries, chemical solutions, oils in oil fields and refineries, irrigation, etc.



Type O D Aurora Horizontally Split Case, Double Suction, Single Stage Centrifugal Pump.

The ultimate in design and perfection—type O D pumps—in capacities to 4,000 G.P.M. and heads to 300 ft.—are accessible, compact and lasting. The horizontally split-case type of design permits removal of upper half of casing without disturbing suction or discharge. The impellers and water channels are streamline designed to minimize flow resistance and avoid turbulence, cavitation and consequent corrosion and erosion.

APCO TURBINE-TYPE PUMPS

For high pressure, Small capacity requirements (up to 150 G.P.M.). Wide operating range characteristics. No metal to metal contacts. Handles non-lubricating liquids without wear. Only one moving part—the impeller.

***Write for* CONDENSED CATALOG "M"**
and O D Bulletin 105

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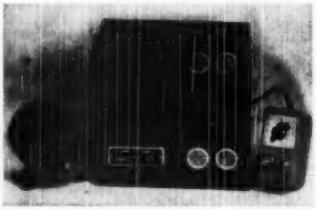
AURORA *Always* PUMPS — AURORA PUMP COMPANY

50 Loucks Street, AURORA, ILLINOIS

NEW EQUIPMENT

(*Continued from page 154*)



MOTOR SPEED-CONTROL **P453**

Thyratron-type speed-control system operates dc motors from an ac line. Shunt-wound 115-v motors from one-thousandth to one-tenth hp may be controlled over a speed range better than 50 to 1 with nearly constant speed versus torque regulation. Another model is available for operation from 220-v line to control shunt motors up to one-sixtieth hp.

Power-supply cabinet measures 8x8x4 and may be wall mounted. Control station case, which may be mounted near motor or near operator's other hand-type controls, is 2x2x4⅛ in.

Servo-Tek Products Co, 4 Godwin Ave, Paterson, N.J.

DC ARC WELDER **P423**

Line of engine-driven, dc arc welders, the WD-40 series, consists of five lightweight mobile units.

One, the WD-42 AGW, is driven by a 31-hp *Wisconsin* VP-4 air-cooled engine with magnetic ignition. Welder weighs 1050 lb; has rated output of 200 amp at 40 v. Unit is also available with 4-cylinder, liquid-cooled *Hercules* engine drive.

Others in the line are the WD-43 AG, 300 amp, 40 v; the WD-44 AG, with welding range from 80 to 500 amp; two 300-amp diesel-driven units, the WD-43 ADGM and the WD-43 ADC; two 400-amp diesel-driven models, the WD-44 ADGM and the WD-44 ADC, all at 40 v.

General Electric Co, Schenectady, N. Y.

LEAD-LINED FITTINGS **P428**

Carbon-steel fittings of welded construction are lined with a bonded lead for chemical-handling and similar service. Lead will not separate or come off unless heat is applied too close to its melting point, 620 F. Full-faced flanges are machined.

A Gunthard Co, Ennis, Texas

FLYASH COLLECTOR **P439**

Small-boiler, low-resistance mechanical flyash collector, the LR, serves the small steam plant of 3500- to 7000-lb-per-hr capacity. Complete information is in the LR bulletin, available through this company.

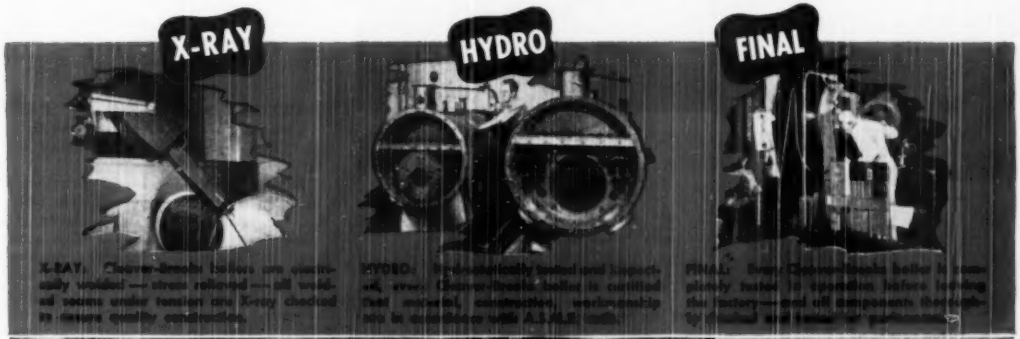
Buell Engineering Co, 70 Pine St, New York 5, N. Y.

ROOM CONDITIONERS **P426**

Six hermetically-sealed room air conditioners are now in production. They range from Models 12 and 13, ½- and ¾-hp, win-

FACTORY-TESTED AND JOB-TESTED

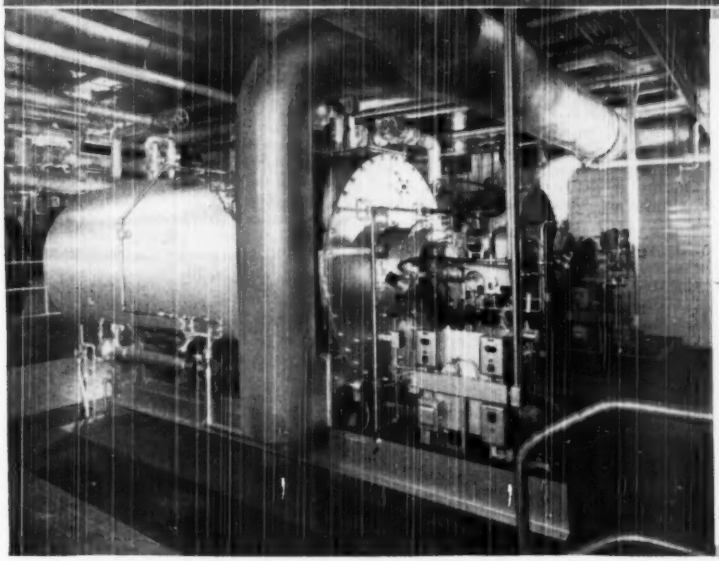
. . . Another Reason Why You Get A Greater Return From Your Investment In A Cleaver-Brooks Steam Boiler



X-RAY: Cleaver-Brooks boilers are ultrasonically tested — stress relieved — all welded seams under tension are X-ray checked to assure quality construction.

HYDRO: Hydrostatically tested and inspected, every Cleaver-Brooks boiler is certified that material, construction, workmanship are in accordance with A.S.M.E. code.

FINAL: Every Cleaver-Brooks boiler is completely tested in operation before leaving the factory — and all components thoroughly checked and tested for performance.



Performance on Location:

Boilers are placed in operation by Cleaver-Brooks service representatives who check installation, operation and make a complete and detailed field report. Your operators are trained in care and operation by Cleaver-Brooks.

Exact and detailed testing—progressively—at successive stages in manufacturing and assembly—operation tests under load at the factory — plus final operation test on location in your plant — these are standard Cleaver-Brooks procedures to assure you in advance of peak performance.

Flexible Operation Burning Gas or Oil With Equal Efficiency: You can use oil, gas, or combination oil and gas, whichever is of lower cost. Through high heat transfer, Cleaver-Brooks boilers operate at a guaranteed efficiency of 80% from full load down to 30% of rating.

In addition, Cleaver-Brooks boilers give you clean, smokeless operation—eliminate fuel—ash handling —require no high or costly stacks— no special foundations — fit under low headroom—provide quick steaming, flexible operation to meet fluctuating loads—fully meet all codes.

Available in sizes 15 to 500 H.P., 15 to 200 P.S.I. — write for new Cleaver-Brooks steam boiler catalog.

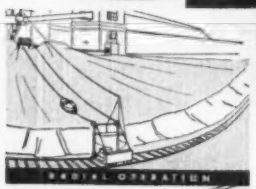
CLEAVER-BROOKS COMPANY, 332 E. Keefe Ave., Milwaukee 12, Wis.

Cleaver-Brooks

STEAM BOILERS

NEW — the Cleaver-Brooks Steam Boiler Catalog—interesting—informative—beautifully illustrated. Write—on your business letterhead—for your copy.

STORE and RECLAIM this better way!



4 TYPES OF SAUERMAN DRAG SCRAPER UNITS

Sketched above are four Sauerman scraper machines. These four machines, suitably modified and adapted to each individual project, are the basic machines with which Sauerman engineers solve most of the problems in open storage of coal.

Small as well as large Coal storage problems are solved economically with a

SAUERMAN POWER SCRAPER

While the big Sauerman installations attract the most attention, it should be remembered that these power drag scraper machines also are made in small and medium sizes to render economical service in storing and reclaiming relatively small tonnages of coal on limited ground areas.

For instance, note the Sauerman installation pictured above. At this power plant, the only space available, for storage was a narrow area of irregular shape, 193 ft. long on its longest side. It was necessary to arrange storage for at least 8,000 tons of coal on this space and to provide a means of storing and reclaiming at a rate of 75 tons an hour.

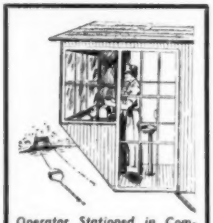
After studying the requirements, the engineers decided the correct solution was a 1½ cu. yd. Sauerman scraper machine equipped with a monorail and trolley. To increase the storage capacity, an 8-ft. concrete wall was built, enclosing the area on three sides. This wall supports the monorail. The scraper tail-block is attached to a trolley riding on the monorail and the trolley is moved by cables controlled by a winch placed alongside the scraper hoist. Thus the operator has at his finger-tips the means of shifting the scraper bucket instantly to any spot in the area.

The chief engineer and other officials of the company are highly satisfied with the solution of their problem. The cost of the entire installation was more reasonable than expected while the operating and repair expense has proved pleasingly low.

Long-Time Users of Sauerman Scrapers Lead in Placing Repeat Orders

Perhaps the best evidence of the satisfaction given by Sauerman scrapers is found in the impressive list of companies—leading public utilities, chemical companies, metal refineries, paper mills, coal mines, rubber factories, cement mills, etc.—that have ordered one after another of these machines through the years to handle storage projects at different locations.

At one plant a company will have a Sauerman machine that has been operating twenty years or longer and at another plant this same company will have a Sauerman installation purchased only last year. It is the record of these old machines, as much as the record of the new Sauerman equipment, that produces the steady flow of repeat orders.



Operator Stationed in Comfortable Cab has Push-Button Control of Every Move of Scraper.

Advice and literature freely supplied. Ask for Sauerman Catalog 19-D and tell us about your coal storage problems.

SAUERMAN BROS., Inc.

562 SO. CLINTON ST. CHICAGO 7, ILLINOIS

dow-sill units, through models 33 and 100, ¾ and 1-hp console units, to models 150 and 200, 1- and 1½-hp commercial and home consoles.

These units have 4-way adjustable air grilles, 7-ply replaceable filters, staggered-tube and corrugated-fin cooling coils. The largest, models 150 and 200, may be equipped with duct work. They carry a selector switch for fan service only, or for cooling where full facilities are used.

York Corp, York, Pa.

POWERHOUSE CEMENT P430

Trowel-applied low-shrinkage weather-resisting powerhouse cement applies for service up to 1700 F.

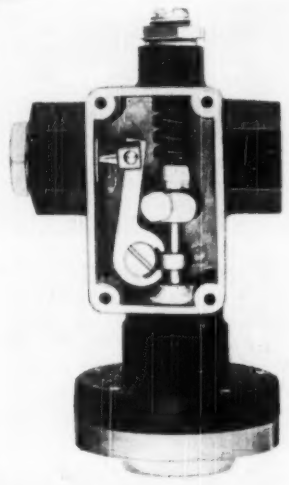
Dry, fibrous material of mineral-wool base can be applied over metal-lath blankets or mineral-wool base insulation. It takes a hydraulic set within 2 hr. A good bond is developed to highly absorptive blocks, and excellent adhesion can be had by first applying a synthetic-resin lagging adhesive.

Baldwin-Hill Co, 500 Breunig Ave, Trenton 2, N. J.

TEST GAGE SET P414

Test set consists of a compound retard gage and pressure gage calibrated to an accuracy of plus or minus 1% of their full range. Both gages have the Marsh *Recalibrator*, which enables the user to readjust the gage hand. Retard scale of the compound gage provides easily read, one-lb graduations through the important testing range of 0 to 50 psi.

Marsh Instrument Co, Jas P Marsh Corp, Skokie, Ill.



PRESSURE REGULATOR P412

Superior Type L-25 steam-pressure regulator is suitable for oil-fired burners with gravity feed. Standard ⅛-in. orifice may be increased to deliver any quantity of fuel desired. Standard inlet pipe size is ½ in. and outlet ¼ in. Regulator comes

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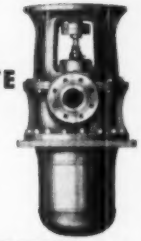
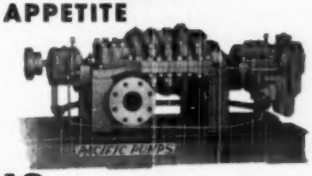
Precision Built FEED PUMPS *Satisfy* YOUR BOILER'S APPETITE*



* FOR THE SMALL APPETITE

19,000 to 165,000 lbs. per hour
VERTICAL—TYPE WBF
DISCHARGE PRESSURES: 100 to 2000 PSI

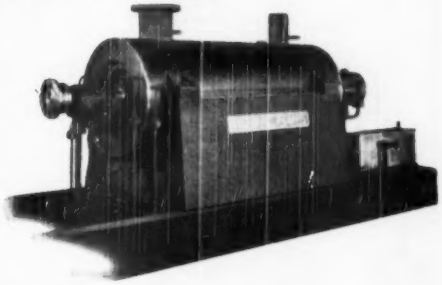


* FOR THE MODERATE APPETITE

45,000 to 475,000 lbs. per hour
TYPE JBF
DISCHARGE PRESSURES: To 1000 PSI

* FOR THE PRODIGIOUS APPETITE

To 1,200,000 lbs. per hour
TYPES ABF and IBF
DISCHARGE PRESSURES: To 3000 PSI



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YOUR PLANT ENGINEERS . . . because they require minimum attention and maintenance; because they are precision-built from materials selected for high resistance to corrosion-erosion and because they are balanced dynamically and hydraulically to eliminate vibration and excessive wear.

YOU, THE OWNER . . . because of their dependability; sustained efficiency and low cost of operation and maintenance.

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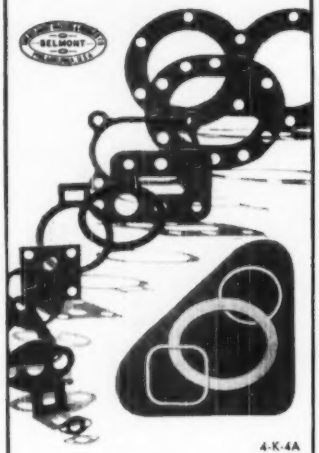
Whether your gasket problem is... temperatures... pressure... vibration... shock... oxidation... corrosion... creep... reduction or just a matter of gasket size and shape, if you want BETTER JOINT AND SURFACE SEALING... longer gasket service life—TRY BELMONT.

Distributors located in every large industrial center to serve you. Write for catalog #40.



4-K-4A

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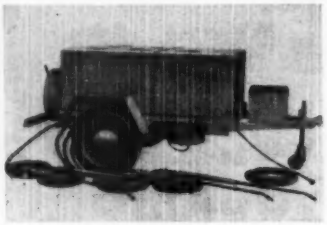
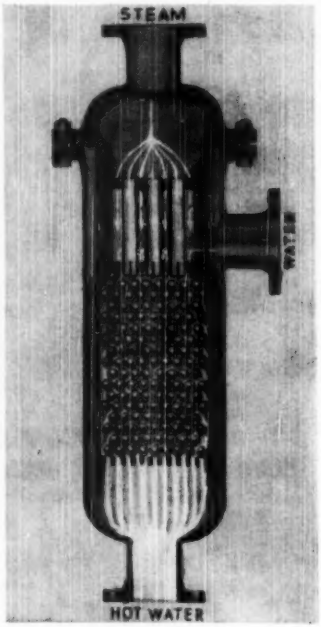
RINGS, SPIRALS, COILS, REELS, SPOOLS, SHEETS, GASKETS.

adjusted for specified steam pressure but is easily readjusted in the field.
Superior Controls Co, Inc, 1835 S Bonnie Brae, Los Angeles 6, Calif.



STEAM-CLEANING MACHINE P416

Hypressure Jenny steam cleaner removes grease, grime and dirt from machinery or can be changed over to a heating generator with output equivalent to about 850,000 Btu. Full operating pressure is reached within two minutes from a cold start. Available in trailer-mounted, portable and stationary models. Standard equipment includes one ½-in. cleaning gun, one 25-ft length of ½-in. and ¾-in. vapor hose, and a choice of either gasoline engine or electric motor drive. Weighs about 1600 lb.
Hypressure Jenny Div, Homestead Valve Mfg Co, Coraopolis, Pa.



HOT-WATER HEATER P429

Instant hot water from 3960- to 31,500-gal-per-hr capacity can be had from one of nine *Hy-Flow* hot-water heaters.

Steam, fed in at top, is directed through an assembly of tubes that act as injectors. Cold water, entering from side, is caught up in the suction created by the moving

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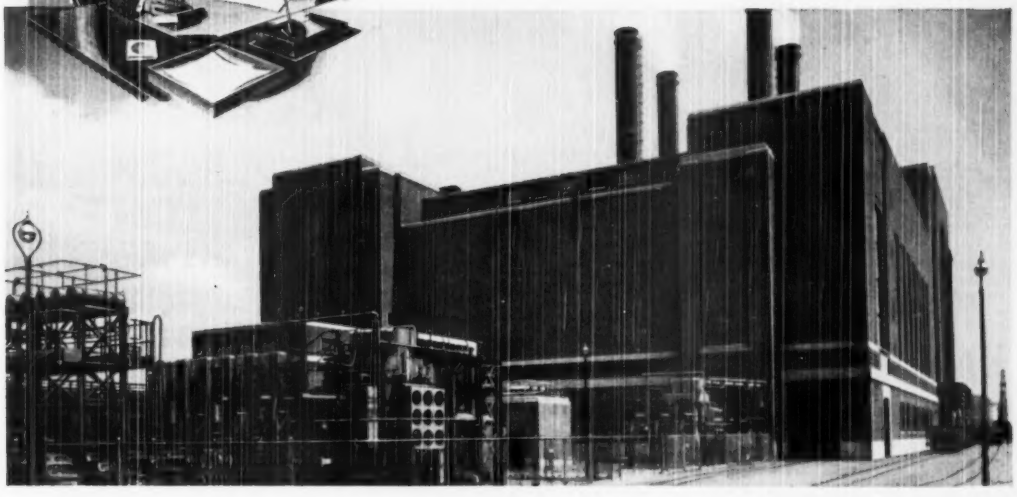
"My bet's on Bituminous-



—the kind that is mined on the B&O!"

Take a tip from executives who think in terms of fuel economy and dependability of supply. These men design their plants for the efficient coals mined in B&O territory.

These coals, available in wide variety for all needs, lend themselves to mechanized, low-cost mining. As they are located close to America's industrial heart, transportation costs are moderate. And because their sources are *known* and *definite*, they can be depended upon —*even during wartime*— for centuries to come.

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HOW TO HANDLE ANY RIGGING JOB

• effectively
• safely

MEET today's problems in industrial and construction rigging with this complete handbook. Use it as your guide to safe and efficient rigging methods and techniques—in transporting or handling heavy machinery or materials . . . in your everyday maintenance operations . . . in erecting or demolishing smaller size structures.

This book enables you to do the job quicker, safer, at lower cost. It shows how to determine the weight of a load, and describes equipment and techniques best suited to its transportation or hoisting. It explains applications, illustrates construction details, gives maintenance tips for all kinds of rigging equipment, shows how to use, inspect and maintain fiber and wire ropes, slings, scaffolds, life belts, cranes and derricks, chain hoists, etc.

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By W. E. ROSSNAGEL

Safety Engineer, Consolidated Edison Co. of New York, Inc.

321 pages, 6 x 9,
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PACKED into the pages of this guide are proven methods that can help you perform your job with greatest safety to all concerned. The book includes simple formulas useful in the accurate calculation of beams and posts, etc. It provides a wealth of data on wire rope installations, and covers every step in rigging operations — from rigging a swinging scaffold and painting a steel stack . . . to using a hydraulic jack and operating a hoist. Reference codes, laws and standards are listed to help you ensure that there will be no violation of local laws, no deviation from safe practices.

Shows how to:
- lubricate wire rope
- rig a basket-hitch sling
- test planks for scaffolds
- operate a spur-geared hoist
- use a suspended scaffold on heavy repair jobs
- test a jack
- and many, many others

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steam. The mixture of steam and water passes over a set of metal barriers that produce an intimate mixture and give uniformly hot water at the bottom discharge.
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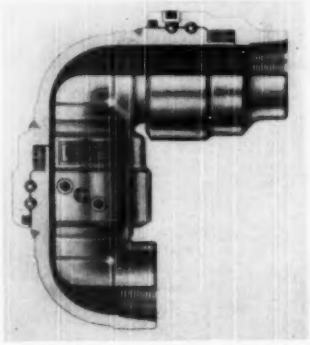


SWIVEL PIPE-COUPLING 442

Handles fluids under high pressure through pipe that swivels or rotates a full 360 deg in all planes. It is free from bolted flanges, threaded sleeves, locking rings and keys. Rotating members are held tightly together with two sets of ball bearings operating in flame-hardened and ground-ball races. Coupling is designed for average rotation speed not to exceed 60 rpm.

A double, metal-backed packer assembly renders the unit pressure tight. It consists of two packers, each with T-shaped metal backer to which a pair of synthetic-rubber lips are vulcanized and bonded. Each backer functions in its own individual chamber. Edges of the metal backer flare outward against the walls of the packer recess, forming a full metallic seal for pressures from vacuum to 12,000 lb per sq in.

High-pressure swivel pipe couplings are steel; low-pressure ones are aluminum, bronze, malleable iron or steel. They are available in a wide size range, and for working temperatures up to 225 F
Gil-Lair Products, Inc, 81 Masonic Court, Pasadena 3, Calif.

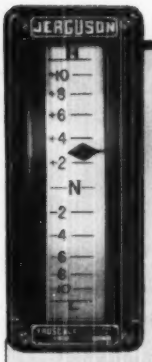
SURFACE PYROMETER P470

Portable, thermocouple-operated pyrometer comes in two models, both for four temperature ranges from 0-400 F to 0-1200 F.

New instrument features a large 4-in. direct-reading indicator mounted in a rubber-cushioned housing. One model has a rigid extension arm while the other has a 12-in. flexible arm for use with any of a selection of eight types of thermocouples.
Pyrometer Instrument Co, Inc, Bergenfield, N. J.

PIPE COUPLING P403

Series 1700 quick-disconnect coupling is made for a 6-in. pipe. It measures 7 in. between flanges and weighs only 17½ lb. Rated at 150 psi. Sealing is by an *O Ring* of synthetic rubber and is easily replaceable. Available in heat-treated aluminum alloy with nipples of heat-treated alloy



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Here is the distance reading gage which incorporates all of the newest engineering features! The Jerguson Truscale has exceptional sensitivity, with the ability to register changes as small as ½ of 1% of range! The translucent dial scale is clearly lighted from behind, and is easy to read.

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Hydrostatic type distance reading gage with inverted U-tube manometer. Water level always visible with space above showing brilliant red. Built-in feature makes possible checking of gage accuracy in few seconds.

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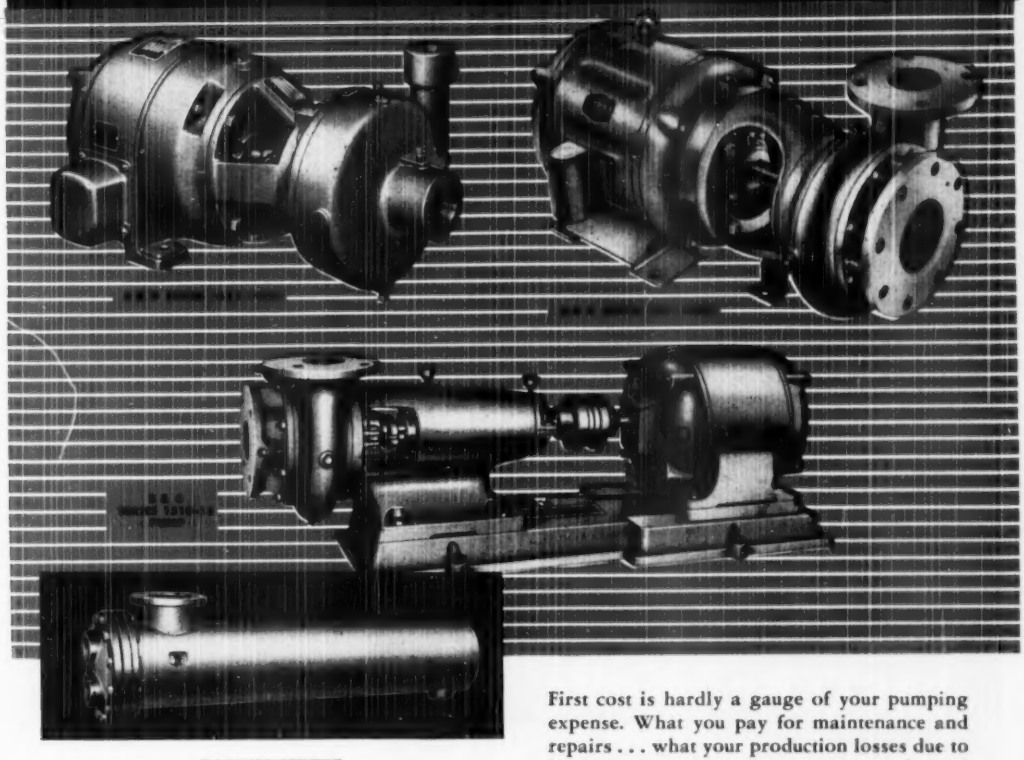

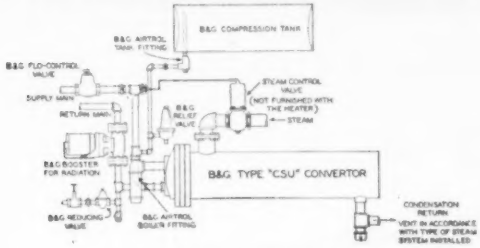

B & G HEAT EXCHANGERS

A complete line of units for steam-to-water and water-to-water heat transfer. Illustrated is the "CSU" Steam Convertor, as used to heat water for a forced hot water heating system. Write for Catalog BN-1048.

First cost is hardly a gauge of your pumping expense. What you pay for maintenance and repairs . . . what your production losses due to breakdowns amount to . . . these are the real measure of pumping costs.

When you select B & G Centrifugal Pumps, your good judgment will be rewarded by long, trouble-free and low cost operation. Design, material and workmanship all combine to produce pumping units which are winning the approval of engineers and operating men everywhere.

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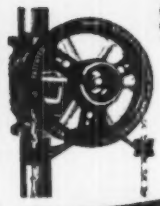

SIMPLIFIES OVERHEAD VALVE CONTROL

Babbitt —Adjustable— SPROCKET RIM with Chain Guide

• Range of 10 adjustable sizes takes care of all valve makes and types: fits valve wheel diameters from 2 to 30 inches.

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• The BABBITT Adjustable Rim fits all valves, with either rising or non-rising stems. It is installed quickly by clamping onto the hand wheel of the valve.

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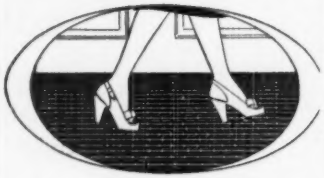
THE SAFE OPEN STEEL FLOORING IS TRI-LOK



No object over ½ square inch can pass through super-safe U-Type Tri-Lok Flooring. Fabricated without bolts, rivets or welds, it is unsurpassed for plant installation, walkways, loading platforms. Efficient distribution of concentrated loads . . . maximum free opening for light and air. Write for Bulletin JZ 1140.

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National Distributor for the Tri-Lok Company

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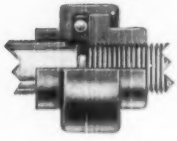
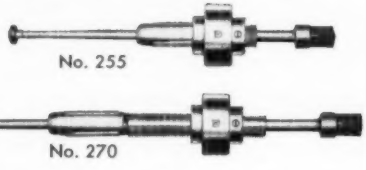
You Get FASTER-SMOOTHER Tube Rolling with IDEAL Tube Expanders

Ball Bearing-Adjustable Thrust Collar





No. 255

No. 270

• Loose collar remains stationary against tube end or sheet, reducing friction to a minimum. Prevents pulling of tube and will not mar sheet—specially ECONOMICAL for production work.

Expanders may be adapted for use with Automatic Torque Controlled Operating Units, for precision tube rolling.

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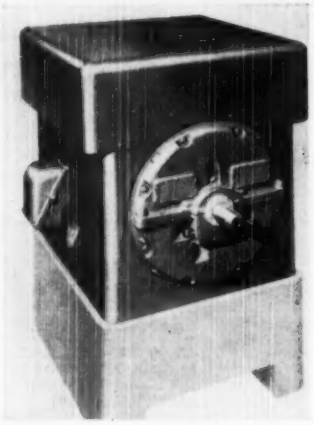

POWER-PLANT MOTOR **P452**

Base-ventilated motor, designed specifically for external applications, such as driving out-of-doors power-station auxiliaries. In ratings from 200 to 3000 hp, motor was developed for those outdoor installations where totally enclosed fan-cooled units are not available.

Unit is designed for mounting on a concrete base that is raised from the ground to allow air to flow through at high velocity. Ventilating air enters the motor through a vertical passage in the base, and is pulled from the ambient-air stream at low velocity. Manufacturer states that, at such low velocity, almost no water or foreign matter can be carried up vertically into the motor. As an additional precaution, baffles are fabricated within the air-intake passage to eliminate small amounts of foreign matter.

General Electric Co, Schenectady 5, N.Y.

PANEL INSTRUMENTS **P475**

Rugged panel instruments are shock tested by 2000 ft lb blows while mounted in panels. On top of that, they get a 6-hr vibration test, and a one-hour tumble test in a large tumbling barrel.

These instruments have a D'Arsonval type of movement, which has had its mass sharply reduced. It is designed to provide electrical accuracy as well as resistance to severe abuse.

Marion Electrical Instrument Co, Manchester, N. H.

AMMONIA COMPRESSORS **P425**

High-speed reciprocating, 15- to 275-hp, VW compressors have been made available for ammonia application. They are designed with 4, 6, 8, 12 and 16 cylinders and for direct connection to motors.

Cylinder liners and other wear parts can be replaced. Precision-built ring-plate-type suction and discharge valves plus spacious gas ports and passages make for quiet operation.

York Corp, York, Pa.

PLANT EQUIPMENT NEWS

Reader Service Page for New Products and Literature

Use the handy FREE service cards for additional information on this month's new products or for copies of latest trade catalogs.

BOILERS AND AUXILIARIES

B32 BOILER RETURN STRAINER—Fred P. Schmidt Engrg. Co., 1155 S. Marshall Blvd., Chicago 23, Ill. 12-page catalog No. 55 describes Schmidt return and boiler return systems. Complete selection tables and specifications for Rivet Arc Head and Applanized and Monel furnished for boiler feed, condensate, heating return, open-type deaerating, and new oxygen-deaerating systems.

B33 CENTRIFUGAL BLOWER — U. S. Air Conditioning Corp., Como Ave. Southeast at 33rd, Minneapolis 14, Minn. 6-page bulletin No. 48-46 describes construction features, illustrated with cut-away diagrams of Multi-Vane Turbo Blowers. Gas coolers are also featured.

B34 DUST COLLECTORS—Aerotyne Division of Chemical Construction Corp., 14 Wall St., New York 5, N. Y. 12-page booklet discusses Aerotyne dust collectors. Design features, general performance data and diagrams are included.

B35 FIRE BRICK—Laclede-Christy Co., 1100 Forbes St., Pittsburgh 19, Pa. 4-page folder No. 303 tells about Laclede Keystone dry-press fireclay brick. Specialties and uses are listed.

All literature designated with a star (★) may be obtained only by writing direct to the manufacturer on company letterhead, giving writer's name and title.

★ FLUID ENERGY REDUCTION MILL—C. S. Wheeler Mfg. Co., STEL Div., 1263 S. Lehigh Ave., Philadelphia 23, Pa. 8-page booklet describes the Stel fluid energy reduction mill, which can be used in the pulverization of coal, ores, minerals, chemicals, foods, grains, etc.

B36 PACKAGE BOILERS — York-Shipley, Inc., York, Pa. 4-page folder describes the longitudinal drum of York power steam-pak generators. These include the following: 3—gas fired (All series) for natural, manufactured, or mixed gas; 3—oil fired (S series) for light fuel oil; 3—combination firing (DS series) for No. 3 oil and gas; 4—oil fired (S series) for No. 4 fuel oil; 4—combination firing (DS series) for No. 5 oil and gas; 6—heavy oil fired (S series) for heavy bunker C oil; 4—combination firing (DS series) for No. 6 oil and gas.

B37 HEATING BOILER—Kewanee Boiler Corp., Kewanee, Ill. 8-page catalog No. KS-6 features the Kewanee Square-Heat Type E steel boiler for heating medium-size buildings. Specifications data for hand-fired coal and for oil, gas or stoker firing are given.

COMPRESSORS AND ACCESSORIES

C1 PORTABLE COMPRESSOR — Davey Compressor Co., Kent, Ohio. Form S-851 contains information on the new Davey Super Chief 40-cfm portable air compressor. Photos show numerous applications.

C2 OIL AND GAS CLEANERS — American Air Filter Co., Louisville 8, Ky. 8-page pamphlet No. 1503 covers new designs and improvements in the Cyrofil oil bath air and gas clean-

HOW TO ORDER ADDITIONAL DATA

Be sure to fill out completely, one coupon for each item of information you order. (See sample, right.) This gives your request authority and helps the manufacturer to address your copy completely.

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are. Schematic charts, dimension tables and detailed engineering data are included.

CONTROLS, ELECTRIC

D18 VOLTAGE REGULATORS — Allis-Chalmers Mfg. Co., 931 S 70th St, Milwaukee, Wis. 12-page booklet No. 07B1468 describes the Allis-Chalmers 90% step JFR pole-type regulator designed to correct rural power voltage conditions and improve service.

D19 MEDIUM RESISTORS — Flexstone Products, Inc., 216 E Clark St, Chicago 16, Ill. 4-page folder presents the Series 100 Resistrips in which the resistors are contained in hermetically sealed units. They are especially applicable for hazardous and corrosive atmospheres.

ELECTRICAL EQUIPMENT

F56 UNIT SUBSTATIONS — Westinghouse Electric Corp., P O Box 2099, Pittsburgh 30, Pa. 24-page booklet No. B-3077 discusses unit substations which provide a source of ac power near the load directly within the mine or factory building. They can also be applied to railway, mining, electrochemical, general industrial, and other specialized fields.

F57 SMALL POWER TRANSFORMERS — Allis-Chalmers Mfg. Co., 931 S 70th St, Milwaukee, Wis. 12-page bulletin No. 07B6084A gives information on small power transformers: single phase, 5 kva and below—2,400 to 4,160 V line, primary; and 2-phase, 60 cycle, 5 kva and below—2,300 to 13,800 V primary.

F58 POWER CABLE — Triumbell Electric Mfg. Co., Plainville, Conn. 40-page booklet No. TEC-5 covers LVD and HALOTHANE insulated heavy-duty cords and cables. Tables, data, construction details, accessories, engineering data and application information are included.

F59 LIGHTNING ARRESTERS — Superior Electric Co., Hannon Ave, Bristol, Conn. 2-page pamphlet No. 7-B features the company's line of Powerohm light distribution equipment. Protective circuit diagrams, outline dimensions and descriptive material are included.

F60 CIRCUIT BREAKERS — Heinemann Electric Co., 712 Plum St, Trenton 2, N. J. 8-page folder No. 5200 explains development, production and advantages of the non-thermal, fully magnetic panelboard circuit breaker.

F61 SELENIUM RECTIFIERS — Augustus Storrs Co., 4668 Bute Island Ave, Chicago 3, Ill. 16-page booklet No. 240 tells about the new 12 Series single- and 2-phase selenium rectifiers. Detailed descriptions and illustrations are given.

F62 ELECTRIC PLANTS — D. W. Onan & Sons, Minneapolis, Minn. Two bulletins are offered. 8-page bulletin No. A-142 covers complete line of Onan gasoline-driven electric plants, ranging from 350 to 15,000 watts, in all standard voltages, frequencies and phases. 4-page form No. A-183 describes the firm's entire line of diesel-driven electric-generating plants.

MAINTENANCE AND SAFETY EQUIPMENT

K23 WAGON DRILLS — Worthington Pump & Machy Corp., Construction Equip Sales Div, Holyoke, Mass. 12-page booklet No. H-1290-B36A presents three models of Worthington water-cooled UAW-69 equipped with a 3-in. cylinder bore, UAW-38 equipped with a 2½-in. cylinder bore, and UAW-30 with a 2-in. cylinder bore.

K24 COMBUSTION SAFEGUARDS — Wheeler Instruments Co, Chicago 7, Ill. 4-page folder No. FS-1 explains the new 1200 Series Flame-o-trol combustion safeguard for oil- and gas-fired furnaces, ovens, boilers, kilns and other heating equipment. A typical application diagram is included.

K25 MINE-CAR CAPS — Kay Co, 1019 McCausland Ave, East St. Louis, Ill. 4-page brochure, entitled "New Life for Old Rollers," describes how old rollers can be rejuvenated at low cost with necessary tube replacements and repairs, and Kay safety hand-hose caps.

K26 SAFETY EQUIPMENT — Gen-ral Scientific Equip Co, 1730 N Huntingdon St, Philadelphia 22, Pa. 44-page catalog, entitled "Everything is Safety," consists of personal protective equipment and industrial safety devices. Price list is included.

MAINTENANCE MATERIALS

L41 SETTLING PACKING — A W Chesterton Co, 6 Ashland St, Everett 49, Mass. 4-page folder gives informative data on Chesterton 644 Austin-Mason plastic metallic packing for use on ammonia, carbon dioxide, steam, air, water, brine, etc. Construction features and advantages are explained.

L42 BATTERY MAINTENANCE — Gould Storage Battery Corp, Trenton 7, N. J. 8-page bulletin, entitled "Instructions for the Maintenance of Gould Batteries for Diesel Engine Cranking Service," presents 10 valuable battery maintenance procedures covering battery care, initial installation through complete operation.

L43 WATERPROOFING — Protexol Laboratories, 11 Ellis St, Cambridge 42, Mass. 4-page leaflet tells about Prufite, a liquid formulation for controlling water seepage and dampness. It may be applied on either interior or exterior surfaces of brick, concrete, cement plaster, stucco and concrete masonry units.

L44 SELF-LUBRICATING PACKINGS — Greene, Tweed & Co, North Wales, Pa. 4-page folder No. LP-10 discusses in detail Palmetto (R) self-lubricating packings for all industrial requirements. Illustrations and specifications are given.

L45 DUST CONTROL — Aerodyne Corp, 130 E 42nd St, New York 17, N. Y. 4-page bulletin, entitled "Controlling Dust in Industrial Plants," explains how many savings stem from dust control with simple, inexpensive Aerodyne chemical wetting process.

L46 AIR-PLACED CONCRETE — Gunite Concrete & Construction Co, 1501 Woodswether Rd, Kansas City 6, Mo. 24-page book No. 10 illustrates applications of Gunite concrete. Physical characteristics and advantages are listed.

MATERIALS HANDLING

M19 SECTIONAL CONVEYOR — Rapids Conveyors Div, Hewitt-Robins, Inc, Passaic, N. J. 6-page bulletin No. 132 gives an illustrated de-

(Continued on page 206)

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D-C Power Costs Cut 20% Yearly!

Mr. R. H. Hill, chief electrical engineer at U. S. Arsenal, Watervliet, N. Y., makes a periodical inspection of G-E mercury-arc rectifier.

G-E rectifiers cut Arsenal's yearly maintenance and operating costs $3500

Mr. R. H. Hill, at the U. S. Government Arsenal, Watervliet, N. Y. is just one of the many forward-looking plant engineers who is cutting his plant's power bill with the new, modern way to get d-c power—by installing mercury-arc power rectifiers.

You can install these units, and then practically forget them. This means big savings in both maintenance and operating costs.

Mr. Hill, for example, says that installing a G-E 400-kw rectifier at the arsenal in 1943 reduced maintenance expense $500 a year. At the same time he reduced operating expense about $3000 a year, because he was able to transfer to other work the operators formerly needed. Total savings of $3500 represent a 20% cut in yearly d-c power costs.

TO CUT YOUR POWER COSTS

Find out today how you can cut your power bills by putting G-E mercury-arc power rectifiers to work in your plant. Call or write your nearest G-E sales office for information. *Apparatus Department, General Electric Company, Schenectady, N. Y.*

G-E Mercury-arc Rectifiers Mean Low-cost D-c Power

GENERAL ELECTRIC

Power-laden Btu's are odds-on-favorites to escape whenever inadequate or no insulation affords the opportunity.

Keep Btu's on the job with efficient, fuel-saving CAREY Industrial Insulation. Cut production costs—raise efficiency—improve employee morale, save fuel!

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a specialized product with a wide temperature range up to 1500°F, low K factor, rugged strength, excellent "Handleability"—

a combination of outstanding qualities . . .

Ask about it!

Don't let Btu's get the jump on you! Call in your CAREY representative today—he's a trained expert, eager to serve you.

CAREY Makes the Complete Line!

85% Magnesia—Industrial Rock Wool—Asbestos—Pipe Coverings—Sheets—Blocks—Batts—Papers—Air-Cell.

Write for your free copy of "Heat Insulation For Industry." Address your request to Dept. PO-4, The Philip Carey Manufacturing Company, Cincinnati 15, Ohio. In Canada: The Philip Carey Company, Ltd., 1557 MacKay Street, Montreal 25, P. Q.

A PRODUCT OF THE HOUSE OF Carey

scription of the new Hewitt-Robins sectional conveyor. Features are fully discussed.

M30 **SHOVEL-CRANES** — Link-Belt Speeder Corp, Cedar Rapids, Iowa. Catalog No. 2322 contains applications, construction details, customer benefits and specifications of the new HC-51 truck-mounted shovel-crane with Speed-o-Matic hydraulic controls.

M31 **ROLLER-CHAIN ASSEMBLY**—Chain Belt Co, 1600 W Bruce St, Milwaukee 4, Wis. 8-page booklet No. 50-6 illustrates and describes Baldwin-Res "BA" riveted roller-chain assembly. Construction diagrams, list prices, specifications and dimensions are included.

METALS AND ALLOYS

R17 **STEEL - CASTING REFERENCE CHARTS**—Lebanon Steel Foundry, Lebanon, Pa. Two newly revised steel-casting reference charts cover 33 selected grades of carbon and low-alloy, stainless, corrosion- and heat-resistant alloys.

R18 **PLATE FABRICATION**—Nooter Corp, 1400 S Second St, St. Louis 4, Mo. 16-page brochure No. 150 offers a pictorial story of fabrication of steel and alloy tanks and pressure vessels. Stainless steel, monel, nickel, copper, aluminum, Hastelloy and clad steels are among the corrosion-resistant alloys presented.

METERS AND INSTRUMENTS, MECHANICAL

T28 **FLOWMETERS** — Schutte & Koerting Co, Dept M-A, 12th & Thompson Sts, Philadelphia 22, Pa. Bulletin No. 18-RB covers the company's complete line of Universal Rotameters, utilizing the HCF (high-capacity fluted) Rotameter tube. Selection data, sizes and dimensions are given.

T29 **DRAFT GAGES**—Ellison Draft Gage Co, 214 W Kinzie St, Chicago 10, Ill. 12-page booklet No. 122 describes construction and operation of the company's line of Straight-Line Bell and Dial Bell draft gages. Diagrams are included.

T30 **FLUID-DENSITY METERS** — Fischer & Porter Co, 76 County Line Rd, Hatboro, Pa. 8-page catalog No. 76 features the new line of Fycnorator instruments for measurement and control of fluid density and specific gravity. Schematic diagrams and photographs are furnished.

T31 **INDUSTRIAL GAGES** — James Morrison Brass Mfg Co, Ltd, 276 King St W, Toronto, Ont., Canada. 42-page catalog No. 85-G contains complete line of gages for pressure or vacuum, for use on water, air, steam, gas, ammonia, hydraulic, etc, for low or high pressure, and high-temperature service.

PIPING, FITTINGS, VALVES AND SPECIALTIES

U41 **METAL HOSE**—Uniflex Metal Hose Corp, Naugatuck, Conn. 8-page publication tells about Uniflex seamless flexible metal hose. Specification data, advantages, and a few simple rules to avoid hose failure are listed.

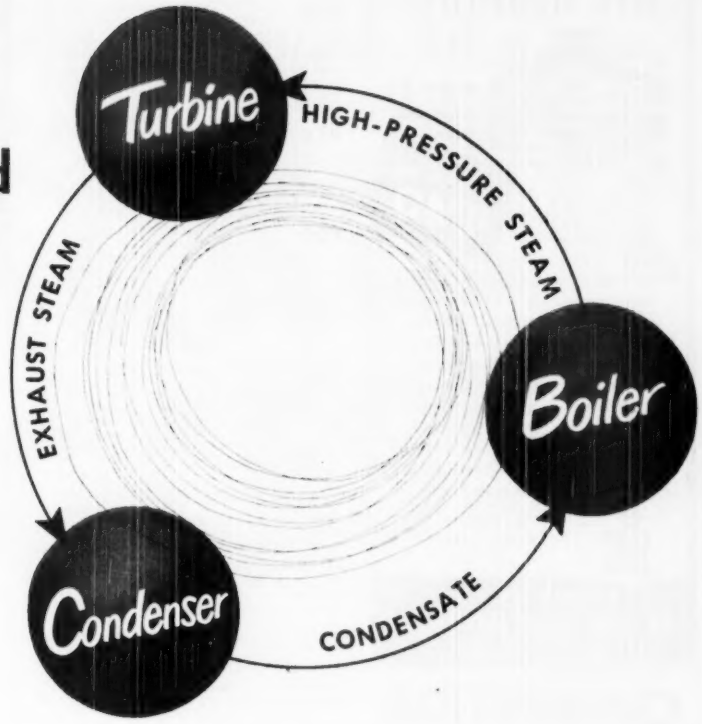
U42 **REDUCING VALVES** — Klipfel Valves Inc, 1000 Weller Ave, Hamilton, Ohio. 24-page booklet No. 148 gives informative data on 30 types of Klipfel reducing valves. A separate handy-selection chart, to use in conjunction with the booklet for determining proper sizes of valves and type needed, is also included.

PRIME MOVERS AND ACCESSORIES

V16 **DUAL-FUEL ENGINES** — Enterprise Engine & Foundry Co, 668 Florida St, San Francisco 10, Calif. 4-page folder No. DF-200 describes in detail the simplified control and gas-admission systems for the new DGSG and DGSQ Series Enterprise dual-fuel engines.

V17 **DIESEL ENGINES** — Detroit Diesel Engine Div, General Motors Corp, 13400 W Outer Drive, Detroit 28, Mich. 10-page pamphlet, en-

Merry-go-round with many problems



THE problems involved in steam generation, steam use, and the subsequent condensation of steam into water are complex and difficult, presenting an almost infinite variety of intricate cross-relationships.

The correct solution of these problems is, however, imperative, for the availability of a boiler depends directly on the proper water treatment and the care and precision with which prescribed procedures are carried out.

Hall Laboratories not only understands these problems but knows their implications in terms of plant construction and operation, and of plant personnel. Hall knows, too, that the answer must ultimately be in terms of dollars and cents.

In these, and in all other problems relating to the industrial use of water, Hall Laboratories is prepared to recommend procedures which, taking all factors into account, represent the most economic and efficient solution *in your specific situation*.

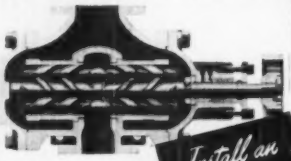
May we send you a copy of the new Hall bulletin "Your Most Important Raw Material"? Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

HALL *plant-wide* WATER SERVICE

BOILER WATER CONDITIONING

PROCUREMENT, TREATMENT, USAGE AND DISPOSAL OF INDUSTRIAL WATER

NEED RELIABILITY?



Install an IMO

In an IMO pump there is practically nothing to get out of order or adjust. The IMO has only three moving parts—a power rotor and two idler rotors. It has no reciprocating members, no valves, no synchronized mechanisms, no pilot gears and no sliding vanes.

IMO pumps can be furnished for practically any capacity and pressure required for oil, hydraulic-control fluids and other liquids.

Send for Bulletin I-143-P

IMO PUMP DIVISION of the
DE LAVAL STEAM TURBINE CO.
TRENTON 2, NEW JERSEY

COMBUSTION ENGINEERING

for power plant men

Become a trained combustion Engineer the easy HAYS way.

Firemen, engineers, fuel and equipment men, etc., can earn bigger pay by becoming a Hays trained combustion engineer. Many employers recognize a HAYS-TRAINED engineer as a better man. Just a little of your spare time required for the easy-reading Hays Home Study Course. Hundreds of others have made better jobs for themselves through Hays training. So can YOU.

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Address_____

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Company Name_____

titled "GM Diesel Quiz," discusses features, characteristics and application of the General Motors diesel engine.

V18 **TWO-CYCLE DIESEL ENGINE** —Nordberg Mfg Co, Milwaukee 7, Wis. 12-page booklet No. 173 features the Nordberg 2-cycle Type TS and TSM2S diesel engine for both stationary and marine service. General description of design, fuel requirements, scavenging system, lubrication and piston cooling system is included.

V19 **SUPERCHARGED DIESELS**—Cummins Engine Co, Columbus, Ind. Two bulletins are offered: No. 5295 covers the supercharged 550 hp (maximum NVHS diesel engine and No. 5294 presents the naturally aspirated 400 hp (maximum) NVH engine.

V20 **STATIONARY DIESELS** — Enterprise Engine & Foundry Co, 668 Florida St, San Francisco 10, Calif. 8-page folder No. H-15 features the Enterprise H Series stationary diesel engines, formerly known as "Hendy 30 Series," ranging from 135 to 265 hp at 600 to 900 rpm in 6 and 8 cylinders.

PUMPS

W32 **DIRECT-FLOW PUMP** — Aldrich Pump Co, Allentown, Pa. 6-page data sheet No. 64 describes the new Aldrich 5-in. stroke triplex direct-flow pump. Information includes construction and design, specifications, dimension drawings, illustrations, selection chart and table, and drive specifications.

W33 **WATER - JET EDUCTORS** — Schutte & Koerting Co, Dept J-A, 12th & Thompson Sts, Philadelphia 22, Pa. 36-page catalog No. 2-M consists of complete line of SK water-jet educators for use in the lifting, pumping, mixing and agitating of liquids and the handling of solids and slurries at low cost.

WELDING

Y13 **ARC WELDERS** — Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y. 36-page booklet presents the Airco line of arc welding machines. Divided into two parts, the first deals with ac arc welders, and the second with dc machines.

Y14 **ELECTRODES**—Hobart Brothers Co, Troy, Ohio. 16-page catalog contains description, application data, welding procedure, mechanical properties and specifications of Hobart electrodes.

Y15 **RODS AND FLUXES**—All-State Welding Alloys Co, 273 Ferris Ave, White Plains, N. Y. 32-page pamphlet lists all the All-State rods and fluxes. Also furnishes characteristics tables, application information, and helpful hints of general interest to workers in metal-joining industries.

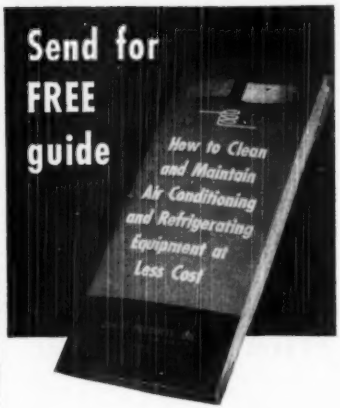
Y16 **FLASH-BUTT WELDING** — American Welding & Mfg Co, Warren, Ohio. 20-page booklet No. CA-50-75 shows advantages of flash-butt welding by controlled techniques. Typical product applications are illustrated.

OTHER EQUIPMENT

Z46 **WATER HEATERS** — Patterson-Kelley Co, East Stroudsburg, Pa. 36-page catalog No. 202 gives informative data on Patterson instantaneous hot-water heaters of 2-, 4- and 6-pass construction. Capacity tables are indexed for selecting heaters from low pressure to 100 lb steam and are tabulated in gallons per hr.

Z47 **INSULATED PIPING**—Ric-Wil Co, Dept J-1, Union Commerce Building, Cleveland, Ohio. Two technical-data booklets are offered: "Insulated Piping System Catalog—Section 480-4" illustrates and describes manufacture, construction and installation of various types of Ric-Wil insulated piping. "Insulated Piping System Technical Data —Section 480-5" contains fully illustrated technical data and specifications on all phases of insulated piping. Its structure, properties, and installation procedures.

Z48 **TORQUE CONVERTER** — Detroit Diesel Engine Div, General Motors Corp, 13400 W Outer Drive, De-



HOW are other plant engineers handling today's problem of maintaining efficiency of air conditioning equipment? What short-cuts are proving successful in conserving water—saving operation expenses through effective maintenance cleaning?

In this new booklet you will find the answers to these and such other problems as . . .

- Controlling Slime
- Removing Hard Water Scale
- Cleaning Water Lines
- Removing Rust

Then, too, there is valuable information on maintenance cleaning of such allied equipment as . . .

- Evaporative Condensers
- Ammonia Condensers
- Glass Filtering Units
- Finned Air-Wash Coils
- Aluminum Plates and Screens

If you think you could use a copy of this booklet—and the number is F7383—simply put your name and address on a penny post card and mail to Oakite Products, Inc., 23 Thames St., New York 6, N. Y.

SPECIALIZED INDUSTRIAL CLEANING
OAKITE
MATERIALS • METHODS • SERVICE

Technical Service Representatives Located in Principal Cities of United States and Canada

Oil in steam condensate reduced to less than .25 p.p.m. with the new . . .

SPARKLER PROCESS

For the first time oil can now be easily and cheaply removed from return steam condensate down to the remarkably low point of .25 p.p.m.; under favorable conditions even as low as .1 p.p.m., and without loss of heat or water softening values.

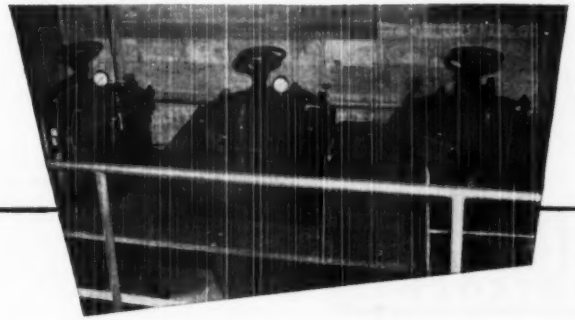
The average skimming or trapping method of oil removal leaves 12 to 20 p.p.m. of emulsified oil in the water. The better oil adsorbent methods now widely used succeed in getting the residual oil down to 3 to 5 p.p.m.

The new Sparkler process, a much improved method based on the oil adsorbent principle, reduces the residual oil to the remarkably low point of .25 p.p.m. with capacity for any required flow rate, and without loss of heat or water softening values.

The engineering details of this new process will be very interesting to any power plant operator who is having difficulty with oil removal from return steam condensate.

Write Mr. K. L. Carr, Sparkler Mfg. Co., Mundelein, Ill. Give details of your problem. Our engineers will personally supervise the installation of this new process in your plant to insure efficient and satisfactory operation.

Filters used in one installation of this process that provide a flow rate of 200 gallons per minute.



SPARKLER MANUFACTURING CO.

MUNDELEIN, ILL.

Makers of industrial horizontal plate filters for over a quarter of a century.

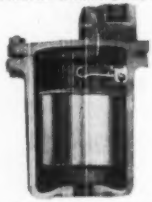
Anyway you figure it....

You get TWICE the VALUE with...

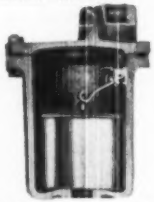
Clark DUO-STEP Leverage STEAM TRAPS

HERE'S HOW DUO-STEP WORKS:

1. Shows orifice closed.



2. First fulcrum point "cracks" orifice.



3. Second fulcrum point moves valve from orifice.

The amazing new Clark Duo-Step design actually *doubles* the drainage capacity of Clark Steam Traps. This means *double value* anyway you figure it. Now you can use smaller, less expensive traps for larger drainage jobs or get *twice* the drainage from traps you have been using.

Sound good? It is! Better look into Clark Duo-Step *today* and start saving real money on your steam trap requirements.

THE CLARK MANUFACTURING COMPANY
1831 East 38th St., Cleveland 14, Ohio

GET THE WHOLE AMAZING STORY, SEND FOR THIS BOOKLET -Today!

Clark DUO-STEP Leverage

Clark FLUID CONTROLS

troit 28, Mich. 24-page booklet, entitled "The New General Motors Diesel Engine—Torque Converter Unit," gives complete information concerning what a torque converter is and how it functions—where and how it has been applied.

Z49 **CHLORINE DISPENSER** — Fischer & Porter, 61 County Line Rd, Hatboro, Pa. 8-page folder No. 61 tells about the company's improved line of Rato-Chlor chlorine dispensers. Design features, operation and applications are listed.

Z50 **CONVERSION TABLE** — Babcock & Wilcox Tube Co, Beaver Falls, Pa. Single card No. TDC-110 contains a linear conversion table for handy reference to engineers who frequently wish to convert inches and fractions of inches into decimal parts of a foot.

Z51 **WATER SCREENS**—Chain Belt Co, 1600 W Bruce St, Milwaukee, Wis. 12-page folder No. 50-36 presents complete line of Rex traveling water screens for effectively screening debris from the intake water. Various types available, design features, and construction details are illustrated and described.

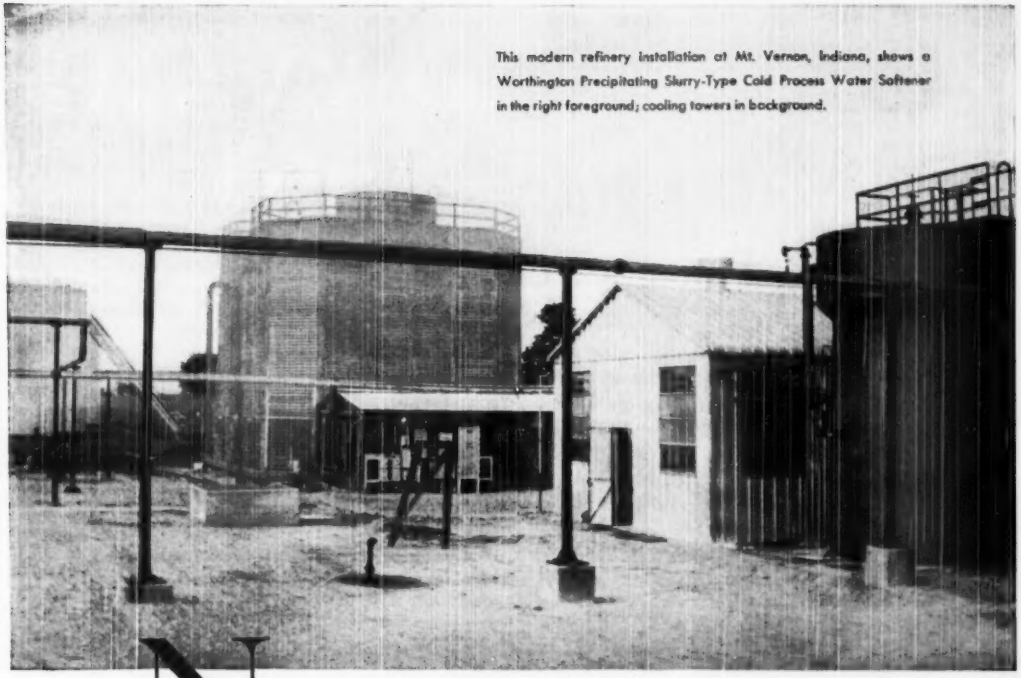
Alcan Studies Power Sites In British Columbia

Aluminum Co of Canada will get a government license to develop the vast water power of the Nechako and Ninika Rivers in British Columbia's Tweedsmuir Park for a projected $500,000,000 aluminum-refining industry. The license covers only the Tweedsmuir Park area, which has an estimated potential of 1,200,000 kw, and does not touch the Chilco River system, a large source of salmon. The company also applied for a license on the Chilco, as a precaution in case the Tweedsmuir scheme proved unworkable. Major R C Farrow, comptroller of water rights, announced at Victoria he was prepared to issue the license.

Alcan, in the midst of a $1,000,000 survey, has so far not found a suitable location on the Nechako for a dam. Diamond drilling at Nechako Butte proved the site unsatisfactory. Surveys last year also covered a powerhouse site, transmission line route and plant site, at the western end of Tweedsmuir Park. Next year investigation will be concentrated on dam sites on the Nechako at the eastern end. There a dam will back up water into a 500-sq-mi lake in an area where several lakes now exist.

Carolina Power & Light Co will spend approximately $18,000,000 this year on its expansion construction program. Projects scheduled during the year include the completion of a second 60,000-hp generating unit at the new Lumberton plant, doubling the station's capacity. The budget also includes work on the new plant now under construction at Goldsboro.

A large Midwestern utility has received a 375,500-lb stator from **Allis Chalmers Mfg Co** for a 125,882-kva turbine-generator. The stator, measuring 29½ by 13½ ft, was completely sealed for shipment. In addition, silica gel was placed in the unit to absorb excess moisture. The stator was dispatched complete wtih windings but the 20,000-lb coolers were removed for separate shipment.



This modern refinery installation at Mt. Vernon, Indiana, shows a Worthington Precipitating Slurry-Type Cold Process Water Softener in the right foreground; cooling towers in background.

No other slurry-type cold process softens water this simple way

NO MECHANICAL AGITATION!

This *unique* Worthington Water Softener assures delivery of the uniformly soft, stabilized, clear water needed for scale-free, corrosion-free cooling water systems.

The unique Worthington feature is the scientific use of hydraulic energy provided by the pressure of the general water supply system to maintain the slurry bed. This eliminates the need for moving agitating parts for mixing the applied chemicals with the preformed precipitate.

WHAT'S YOUR WATER TREATING PROBLEM?

The right water conditioning process for one problem may be wrong for another. That's why it pays to call in Worthington, the century-old water-handling equipment maker that knows more about the complicated problems of applying *all four* water conditioning processes than anybody else. Remember, Worthington makes all the essential elements of all kinds of systems. So, by putting complete control and responsibility in the hands of one reliable manufacturer, you can be sure that your water conditioning plant is right for you.

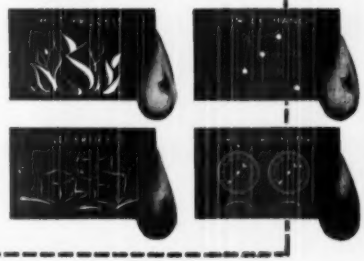
Write today for more information about cold process water softening, and further proof that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Water Treating Division, Harrison, N. J.*

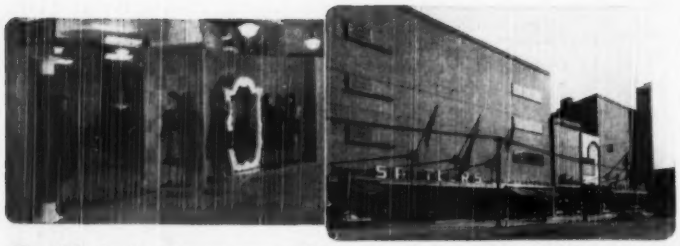
J8-A

WORTHINGTON

WATER CONDITIONING

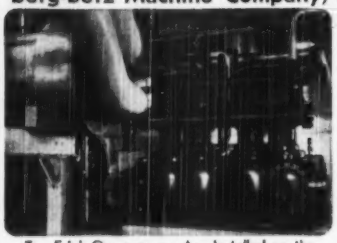
Worthington Makes More of the Equipment for All Types of Water Conditioning Systems





Buffalo's Largest Store Air Conditioned throughout with Frick Refrigeration

Sattler's Department Store, covering most of a large city block, serves up to 150,000 people in a single day. The giant store is cooled in hot weather with ten Frick ammonia compressors using 920 horsepower. Installation by Mollenberg-Betz Machine Company, Frick Sales Representatives at Buffalo.



Ten Frick Compressors Are Installed on the Roof of Sattler's Store at Buffalo.

For that important air conditioning, ice-making, refrigerating or quick-freezing job of yours, get in touch now with the nearest Frick Branch or Distributor.

DEPENDABLE REFRIGERATION SINCE 1883
FRICK CO.
WAYNESBORO, PENNA. U.S.A.
Also Builders of Power Farming and Sawmill Machinery

YOU CAN CUT PIPING COSTS with CATAWISSA PERFECT SEAL UNIONS
CATAWISSA HOT FORGED STEEL UNIONS priced to compete with better grade malleable iron unions
also . . . DOUBLE EXTRA HEAVY FORGED STEEL SWING CHECK VALVES 600-lbs. W.S.P.
a type for every use! CATAWISSA STAINLESS STEEL UNIONS machined from solid bars
WRITE FOR BULLETIN 10-A
CATAWISSA VALVE & FITTINGS CO.
206 Mill St. • CATAWISSA, PA.

POWER NEWS

(*Continued from page* 142)

New processes for both products are being developed and older ones improved in efficiency. A gaseous diffusion plant is having an addition put in for separating uranium 235 from nonfissionable uranium 238.

Research has been moving right along. A number of research tools have been invented. Two new proton synchrotons are building. They will furnish controlled beams of particles that permit exploring the atomic nuclei and the forces within them.

Metal and alloy studies are under way at University of California under AEC sponsorship. Three different projects are devoted to diffusion in solid metals. GE Research Labs has one; Sylvania Electric Products, a second; the third is shared by MIT, GE and University of Pittsburgh.

Power Conference Meets In Pittsburgh

First AIEE power conference, sponsored by the AIEE National Technical Committees on Power Generation, Industrial Power Systems and System Engineering, will be held at the Wm Penn Hotel, Pittsburgh, April 19-20. Eighteen papers will be presented.

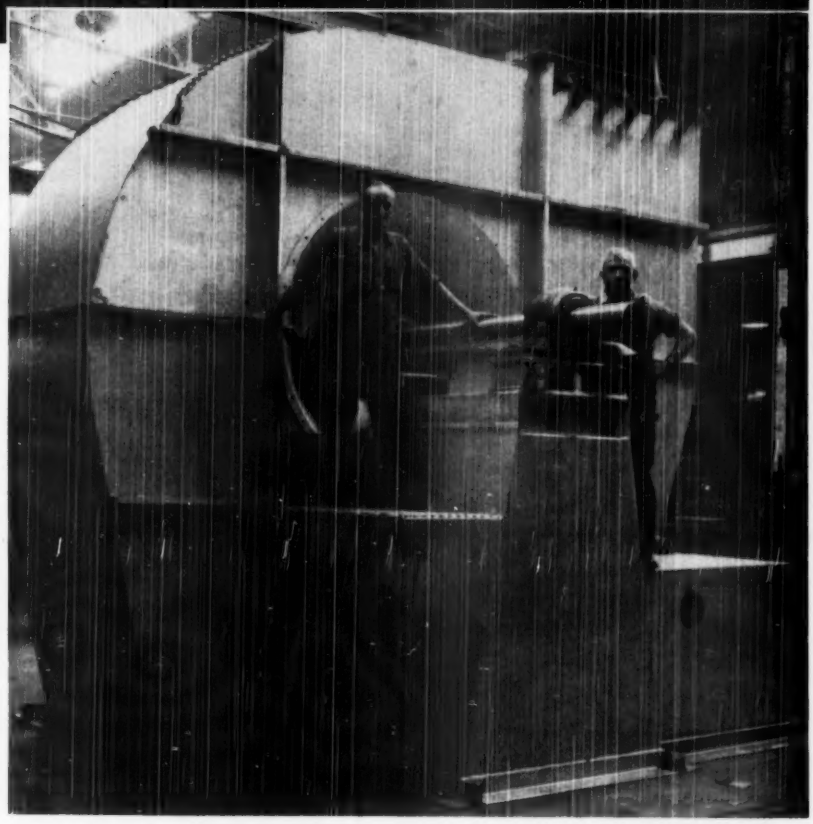
Typical of the papers are: *Survey of New Station Costs*, by A E Knowlton of *Electrical World*; *Maintenance and Overhaul Scheduling*, by W C Bryson of Duquesne Light Co; *Steam Station Efficiency Control*, by B G A Skrotzki of POWER; *Modern Trends in Industrial Electric Power Distribution*, by D H McIntosh of Allis-Chalmers Mfg Co; *Supplying Power to Industry*, by F F Dickman of West Penn Power Co.

Chevah Hydro-Electric Development, owned by Carolina Aluminum Co, a subsidiary of Aluminum Co of America, has just expanded its generating facilities by about 35% with a 40,000-hp Francis-type turbine-generator.

Radioactive material suitable for industrial radiography in place of radium can be used by the **St John XRay Labs** of Califon, N. J. They have in stock a 350 millicuries source of cobalt 60, which has a smaller focal point than radium and gives better results.

First United States **International Trade Fair** has been planned for Chicago this year, Aug 7-9, 1950. It will mark the first international exposition for industry and commerce ever held in the U.S.A. The Commerce Dept, ECA, DEEC and International Chamber of Commerce have approved. A ratio of one-third American to two-thirds foreign will govern exhibitors at the exposition halls on Navy Pier, International Amphitheatre, Coliseum and Arena.

HEAVY Construction . . . Extra Years of Service



ONE OF THE LARGEST EXHAUST FANS EVER BUILT — 14 feet high, 14½ feet wide, 11 feet deep — weight, 16,250 pounds . . . two of these fans sold by Clarage Chicago office late last year to operate as essential parts of the equipment required to dry freshly mined coal.

88,600 CUBIC FEET OF AIR PER MINUTE AT 275° F. is each fan's capacity . . . fan wheel is central disc type with cast steel hub and ⅜" (thick) steel blades . . . shaft and bearings, 6½" diameter. This heavy construction of Clarage Fans will be long appreciated on this unusually severe service job.

SEE OUR CATALOG IN SWEET'S

Equipment for many of the biggest, most important air handling jobs in the country is furnished by Clarage. Through the years architects, engineers, contractors, users have come to rely on Clarage equipment for long time service at operating and upkeep costs surprisingly low. May we "work with you" on your next job in our field?

CLARAGE
FAN COMPANY
Kalamazoo, Michigan

HEADQUARTERS for Air Handling and Conditioning

SALES APPLICATION OFFICES . . . . . IN ALL PRINCIPAL CITIES

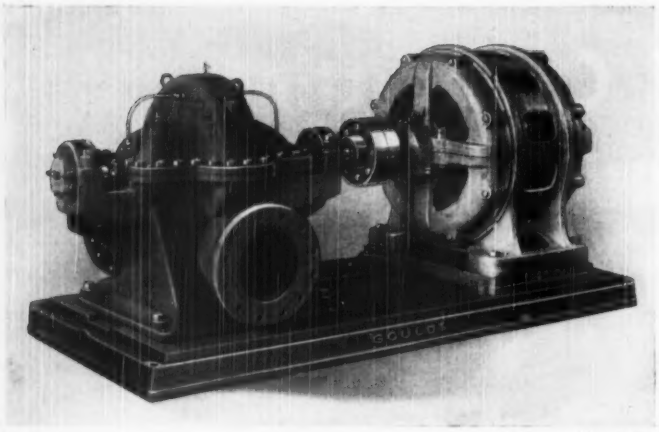


Fig. 3450

For heavy duty, large capacity jobs . . . Goulds double suction centrifugals

TYPE	USES	ADVANTAGES
Centrifugal, single stage double suction with horizontally split casing. Capacities: to 15,000 G.P.M. Heads: to 500 feet depending on capacity. Sizes: 2" to 16".	General water supply; water works; circulating and booster service; low pressure boiler feeding.	Rugged, heavy duty construction; may be dismantled without disturbing pipe connections. Made in bronze fitted, all iron, and all bronze constructions.

Other Examples of Goulds Complete Line

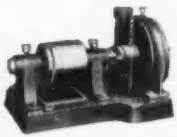


Fig. 3010—Cap. 5 to 100 G.P.M. Heads to 70 ft. Sizes 1", 1½", 2".

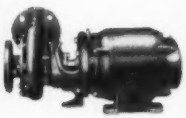


Fig. 3650—Cap. to 2000 G.P.M. Heads to 400 ft. Sizes1" to 6".

Fig. 3105—Cap. 250 to 4500 G.P.M. Heads to 220 ft. Sizes 4" to 8".

Fig. 3648—Cap. to 35 G.P.M. Pressures to 190 lbs. Sizes ¼ H.P. to 5 H.P.

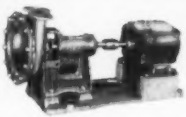


Fig. 3705—Stainless Steel —Cap. to 600 G.P.M. Heads to 200 ft. Sizes 1" to 3".

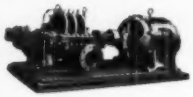


Fig. 3330—Cap. 40 to 2000 G.P.M. Heads to 3200 ft. Sizes 2" to 8".

Goulds Has The Right Pump For Your Job

The above are only six of the more than 180 types and sizes of pumps that Goulds makes. Pumps are our only business—have been for over 100 years.

The *right pump* for your job saves you money. Phone or write Pump Headquarters or your nearest Goulds representative for their recommendation on any pump job you may have.

MEMBER

Goulds PUMPS INC.
Seneca Falls
New York

Wind Power in Great Britain

Wind power is attracting attention in Great Britain where the Electrical Research Assn. has submitted two reports: (1) *The Potentialities of Wind Power for Electricity Generation (With Special Reference to Small-Scale Operation)* and (2) *Large-Scale Generation of Electricity by Wind—Preliminary Report.* Certain parts of Great Britain, such as the Orkney Islands off North Scotland, and parts of Wales have favorable wind conditions for power generation. The best of these are at the former location where the North Scotland Hydro-Electric Board plans to install a 100-kw unit to operate in parallel with a diesel plant.

Several small wind-power units now operate in different parts of Great Britain. Most of these generate direct current and operate in parallel with storage batteries. In Denmark there are about 60 such units in operation, for capacities of 30 to 70 kw. There are also isolated units serving single systems.

All these units are small compared to the 1250-kw unit installed on Grandpa's Knob, a mountain near Rutland, Vt. Until it lost one of its blades this unit operated under governor control in parallel with the power system of the Central Vermont Public Service Corp. Considerable study has also been given by the Federal Power Commission to the design and construction of windpower plants in the U.S. These studies have not got beyond the preliminary stages.

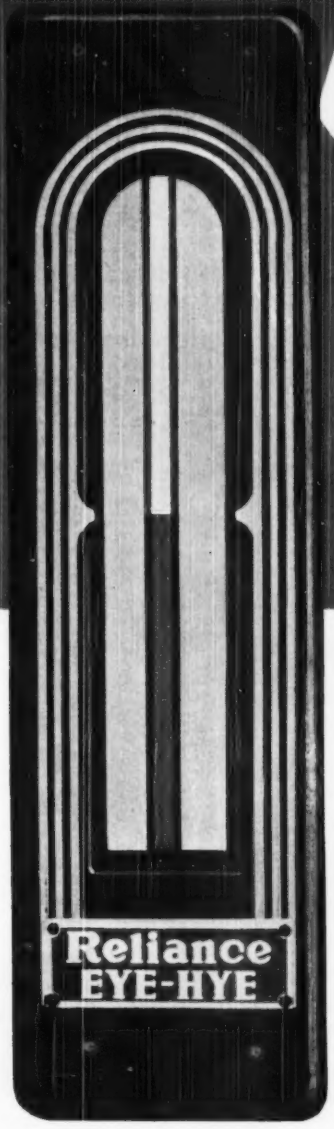
Construction of a 20,000-kw unit has been proposed in Germany. But in the present state of the art such a unit sounds a little over-ambitious.

Rome Cable Corp, Rome, N. Y., announces the acquisition of Anderson-Carlson Mfg Co, Torrance, Calif., manufacturers of electric metallic turbine for the construction industry since 1946. The California plant will continue operation under direction of Arthur A Andersen, president, and Gilbert Woodill, executive secretary. No change in personnel is contemplated.

Sale of Andersen-Carlson tubing has been handled by Rome Cable since the start of production in Oct 1948. With this acquisition, Rome Cable supplements its line of copper rods, bare and tinned wire and cables for the utility, construction, electrical manufacturing, mining, railroad and other industries. The California plant product is sold through the electrical wholesalers. Through this channel much of Rome Cable's wire products are distributed.

Florida Power & Light Co plans a construction program of $18,000,000 for the year, according to President MacGregor Smith. Facilities will be constructed for an anticipated 30,000 new customers.

Among the most important projects will be the start of the new $10,000,000 steam station at Palatka on the St. Johns River. The 72,000-kw Cutler station, south of Miami, will be completed, and a new unit added to the Sarasota plant to double its present capacity.



It's EYE-HYE

...that gives you a true

"liquid column"

water level reading

remote from the boiler

Easy to Install
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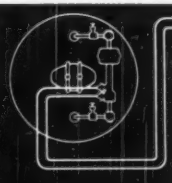
Easy to Maintain

The easiest, most natural way to read boiler water levels is in *liquid* fluctuating between two points that show high and low danger limits. Reliance EYE-HYE Remote Reading Gage brings gage reading to convenient eye-height position—shows water level clearly in illuminated green liquid. EYE-HYE is accurate—sensitive to slight level changes. Reading EYE-HYE is accurate, too. You get its message at a glance—*faster* even than you can see dull-colored water in the usual gage.

EYE-HYE is all-hydrostatic—has no mechanical parts. It's easy to install—easy to read—needs practically no maintenance. *Write for Catalog CO.*

The Reliance Gauge Column Co. • 5902 Carnegie Avenue, Cleveland 3, Ohio



Reliance EYE-HYE

Remote Reading Gage

All-hydrostatic • Reads like a tubular glass gage

Remove Oil...

FROM BOILER AND PROCESS WATERS THIS NEW LOW-COST WAY!

What it is —

Filtration with Sorbo-Cel is a simple, low-cost method of removing emulsified oil from water. In plants using steam generating equipment, it is proving an especially effective and economical means of obtaining oil-free condensate for boiler feed. It also provides a practical solution to other oil-contaminated water problems, such as the water used in pumps, condensers, cooling systems, moving driers, etc.

How it works —

The method is similar to that used in other conventional industrial filtration operations. A small amount of Sorbo-Cel (a specially processed diatomaceous silica powder), is added to the water to be filtered. This is then pumped through a pressure filter where the oil globules are adsorbed by the specially treated Sorbo-Cel particles. Both are retained on the filter screen, the filtered water alone passing through. Any type of pressure filter having a metal screen and capable of operation at a pressure differential of 30 psi or more may be used.

What its advantages are —

Sorbo-Cel filtration is fast, economical and efficient. It assures virtually complete removal of oil, as well as suspended solids such as rust, scale, clay, etc. Large volumes of water are filtered in a relatively short time, yet total costs (including both material and operation) range from only 1¢ to 3¢ per 1000 gallons of water filtered.

For further information about Sorbo-Cel filtration use the coupon below.

JM

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Johns-Manville
Box 290, New York 16, N. Y.

Send me free bulletin giving advantages of Sorbo-Cel filtration.

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Company_____

Address_____

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APPOINTMENTS

Foster Wheeler Corp, New York City, elects Vice-Admiral Earle W Mills, U. S. Navy (retired), president of the corporation. David McCulloch, as chairman of the board, succeeds Harry Sanford Brown, who died suddenly Feb 18.

John Horth has been named manager of **De Laval Steam Tubine Co's** St. Louis office. H. H. Reynolds has become manager of Los Angeles office.

Dampney Co of America announces appointment of R E Mundy Co, 1520 Cleveland, S W, Roanoke, Va., as sales representative in central Virginia and adjacent territory in West Virginia.

K R Knoblauch is promoted to manager of sales of valve products for industrial division of **Minneapolis-Honeywell Regulator Co.** He will continue to make his headquarters at the Brown plant in Philadelphia.

American Locomotive Co, Schenectady, N. Y., has chosen Erskine W Manterfield to replace Holmes Brown, who has resigned, as director of public relations and advertising.

Thomas D Hogg joins the staff of **Control Engineering Corp,** Canton, Mass., as plant manager.

York Corp has selected the following as its distributors: Calcasieu Lumber Co, 201 W 2nd St, Austin, Texas for Texas counties of Mills, San Saba, Lampasas, Mason, Llano, Burnet, Bell, Gillespie, Fayette, Burleson, Blanco, Travis, Williamson, Milam, Hays, Caldwell, Bastrop and Lee; Clayton C Smith Co, 702 Mulberry St, Williamsport, Pa., for Pennsylvania counties of Lycoming, Sullivan, Union, Montour and portions of Centre, Clinton and Northumberland; Hawes Electric Co, 333 Washington Ave, Huntington, W. Va., for counties of Cabell, Lincoln, Mason, Wayne and Putman in West Virginia, and Boyd, Floyd, Johnson, Lawrence, Martin and Pike counties in Kentucky; Modernized Equip Co, 922 Race St, Cincinnati, for counties of Brown, Butler, Clermont, Clinton, Hamilton, Highland and Warrent in Ohio, counties of Dearborn, Franklin and Ohio in Indiana, and counties of Boone, Bracken, Campbell, Gallatin, Grant, Kenton, Mason, Pendleton and Robertson in Kentucky.

Frederick Bohen, president of Meredith Publishing Co, Des Moines, Ia., is elected a member of the board of directors of **Allis-Chalmers Mfg Co,** Milwaukee, Wis. He succeeds the late Arthur W Butler of New York. Frank R Freyler replaces William Arthur as manager of Mid-Atlantic region. Arthur is retiring. Freyler is succeeded by Arthur D Brown as manager of Philadelphia district office. New manager of Washington office is R N Landreth. J S Morgan becomes manager of switchgear section of the electrical dept.

Link-Belt Co, Chicago, has appointed H Walter Regensburger chief engineer of its general engineering dept to replace Harry L Strube, who has retired. The engineering

PANALARM

The Universal, Safe, Multi-Unit Signals

WARNS of DANGER with SIGHT and SOUND Signals

Typical Installation

Shown below is a typical operating cycle of one type of Panalarm sight-sound signals:

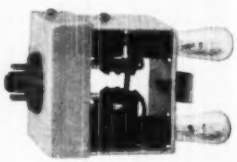
RED LIGHT warns of danger or off-normal; horn sounds

GREEN LIGHT indicates normal operation

NAME PLATE designates monitored unit

ACKNOWLEDGING BUTTON stops horn until trouble is corrected

Many other combinations of signal sequences are available to fit existing systems, or to provide other types of sight and sound warnings.



Self-Contained Units

Panalarm lights and relays are contained in a compact plug-in unit, available from front of panel; installed as simply as inserting a vacuum tube. Lock-in and interlocking systems furnished where necessary.

Basic Cabinet

Panalarm cabinets are furnished in unit sizes to fit your needs; contain terminal blocks and octal sockets — all readily accessible from front. Panel or wall-mounted.

SERIES 400

Series 400 Panalarms are hermetically-sealed for use in hazardous locations or atmospheres. Available in same types and sequences as unsealed units.

Write for Panalarm Bulletins: Series 300 and Series 400, containing complete data, mounting dimensions, etc.

PANALARM PRODUCTS
A Division of PANELLIT, Inc.
7218 N. Clark St., Chicago 26, Ill.

The *Maxiflow* has all 3 · · ·

CAPACITY
PERFORMANCE
ECONOMY

Incorporated in Consolidated Maxiflow Safety Valves are design and performance advantages that are the results of over 70 years of valve manufacturing experience.

MAJOR FEATURES INCLUDE—

The Thermodisc—Designed to permit rapid equalization of temperature differentials set up when a high-pressure safety valve reseats after blowing. Thermal stresses are minimized. Seat distortion cannot take place. Permanent tightness is achieved.

Mechanical Through Bushing—Precision machined surfaces provide constant entrance conditions for steam flow. Eliminates leakage due to porous castings. Selection of material with high strength and creep resistance values at elevated temperatures is made possible. Added strength in the valve neck is also obtained.

Control of Blowdown—The Maxiflow has been specifically designed to function with a blowdown as low as one (1) per cent. The exclusive "micrometer" trim ring provides a simple and practical chatterproof blowdown control—externally controlled and can be made with valve under pressure.

Retention of Popping Point—Change in the popping point, due to temperature difference, is held to a minimum in the Maxiflow. This is achieved by combining proper compensation with materials having low coefficients of expansion. Special alloy steel is used to obtain stability of spring support in the yoke rods, and the stainless steel spindle compensates thermally for elongation of other parts which would affect spring loading.

Consolidated Maxiflow Safety Valves are available in either welding or flanged inlet.

Pressure range is from 250# to 2500#. Temperatures to 1100° F.

For a complete description plus capacity tables, write for the Consolidated Maxiflow Safety Valve Bulletin.

CONSOLIDATED *SAFETY* VALVES

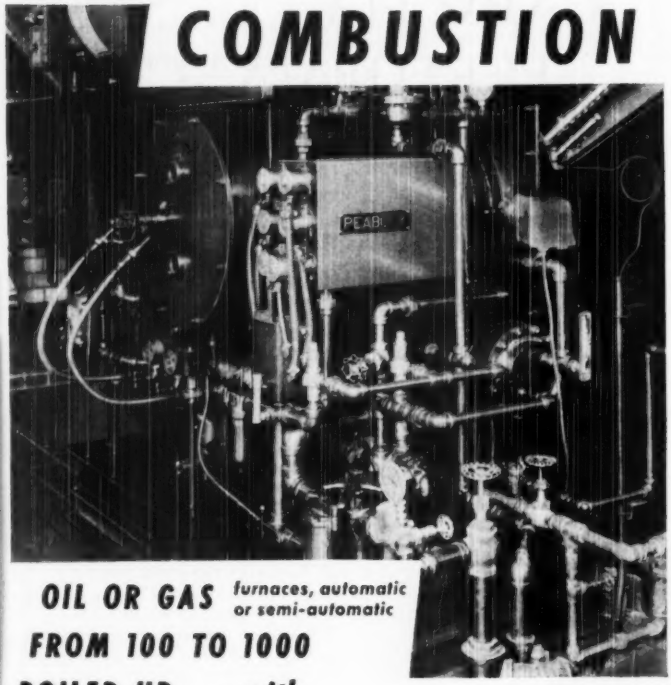
A Product of

MANNING, MAXWELL & MOORE, INC.
BRIDGEPORT, CONNECTICUT

Makers of 'Consolidated' Safety and Relief Valves, 'American' Industrial and 'Microsen' Electrical Instruments, 'Hancock' Valves, 'Ashcroft' Gauges. Builders of 'Shaw-Box' Cranes, 'Budgit' and 'Load Lifter' Hoists, and other lifting specialties.

CLEAN
COMPACT
AND

AUTOMATIC COMBUSTION



OIL OR GAS *furnaces, automatic or semi-automatic*
FROM 100 TO 1000
BOILER HP . . . with

PEABODY Automatic Burners

Complete and ready to go—just connect to service lines and you have an entire combustion system that handles heavy Bunker "C" oil from storage tank to combustion. Equally effective and convenient on the lighter fuel oils. This unit pumps, preheats, pressurizes and delivers oil to burner at proper viscosity, ignites and then burns it at proper firing rate. No auxiliary equipment required, no extra construction or engineering. Factory-mounted on single, reinforced base plate. Listed by Underwriter's Laboratories. Dependable and proved in the field! Write for Bulletin 400.

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ENGINEERING CORPORATION
580 FIFTH AVENUE • NEW YORK 19, N. Y.
Manufacturers of all types of combustion equipment, direct-fired air heaters, gas scrubbers, coolers, and absorbers

PEABODY LIMITED • LONDON, S.W. 15, ENGLAND

dept has been transferred from Philadelphia to 301 W Pershing Rd, Chicago. Assisting Regensburger will be Charles M Young Jr as chief developmental engineer, and Harold F Watson as chief standards engineer.

Tulsa, Okla. office of Tube Turns Inc is now at 420 Wright Building. Robert S Tyler Jr is manager.

Manning, Maxwell & Moore Inc, Bridgeport, Conn., announces retirement of William J Jarrett as vice-president and controller. John A Flynn becomes acting controller. Also, Colby M Chester is elected chairman of the board of directors and Robert R Wason is re-elected president.

Richard S Wharton has joined **Hewitt-Robins Inc,** New York, as sales manager of Hewitt Rubber Div.

Flexitallic Gasket Co, Camden, N. J., selects the following as agents and distributors: Moorlane Co, Tulsa, Okla., distributor, with branches in Kansas City, Amarillo, Denver, Oklahoma City and Wichita; Boiler Equipment Service Co, 686 Greenwood Ave, N E, Atlanta, Ga., agent, for territory of Alabama, Florida, Georgia, North and South Carolina and Tennessee; Lane Machinery Co, Inc, Buder Building, St. Louis 1, Mo., agent, serving eastern Missouri, southern Illinois, western Kentucky, western Tennessee and northeastern Arkansas; Plant Equipment Inc, 607 Sexton Bldg, Minneapolis 15, Minn., agent, for Minnesota, North and South Dakota, western Wisconsin and northwestern Michigan; Consultores Y Abastecedores Industriales, S. A., Dolores No. 17-301 Mexico City, distributor, serving Republic of Mexico.

R F Turner assumes duties of sales manager—dealer products dept of **Philip Carey Mfg Co,** Cincinnati, Ohio. C W Ainsley is now sales manager of both industrial dept and home insulation dept.

Edward R McPherson Jr, of Cummings & Lockwood law firm, Stamford, Conn., has been elected to board of directors of **Jenkins Bros,** New York City.

General Electric Co announces following appointments: Robert S Neblett is promoted to business and construction manager of Knolls Atomic Power Laboratory. Neblett will handle all business and contractual relations between the laboratory and the AEC. J E Ryan and C P Hayes are made staff assistants to B A Case, manager of engineering of GE's small apparatus divs. Max I Alimansky becomes assistant to manager of engineering, transformer and allied product div. Succeeding Alimansky as engineer of capacitor divs is Merritt E Scoville.

H F Lefferty succeeds H P Curtis, who resigned, as Pacific Coast sales manager for **Babcock & Wilcox Tube Co.** Lefferty's headquarters will be in the Petroleum Bldg, Los Angeles, Calif.

Wagner Electric Corp establishes two additional electrical sales offices: New Orleans office, a sub-branch of St. Louis sales under direction of N G Alvis, is at

FOR

✓ ***softening***

dealkalization

deionization

silica-removal

Monobed deionization

A complete line of

AMBERLITE

ion exchange resins

In a pamphlet that belongs under the glass on your desk top we've condensed a part of our knowledge on the use of AMBERLITE IR-120 in water softening. The extremely high capacity of the resin, even when operated at low regeneration levels, is described. The effects of flow rates and water temperatures on headloss and expansion are tabulated. And we've squeezed into 5 tables and 811 words a description of the resin that resists acid, alkali, chlorine, heat, attrition, and waters low in silica.

If you plan to install a new high-capacity softening unit or if you want to replace zeolites of low capacity with a resin of high capacity and efficiency, you owe it to your boilers to write Department **PI-2** for your copy of the pamphlet on AMBERLITE IR-120.

Send for this free folder today

CHEMICALS FOR INDUSTRY

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THE RESINOUS PRODUCTS DIVISION

Washington Square Philadelphia 5, Pa.

The Resinous Products Division was formerly The Resinous Products & Chemical Company

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Linings for
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AUTOMATIC CONTROLS FOR INDUSTRIAL APPLICATIONS REQUIRING POSITIVE CONTROL OF PRESSURE, TEMPERATURE, LIQUID LEVEL ETC.
SIMPLE TO ADJUST FOR THE SPECIFIED OPERATING RANGE
MERCOID CONTROLS ARE EQUIPPED WITH MERCURY SWITCHES, THEREBY INSURING GREATER SAFETY, BETTER PERFORMANCE AND LONGER CONTROL LIFE
WRITE FOR CATALOG 600-B. PLEASE MENTION THIS PUBLICATION
THE MERCOID CORPORATION
4201 BELMONT AVE. CHICAGO 41, ILL.

227 International Trade Mart. Davenport office, located in the Kahl Bldg, is under direction of S R Snyder and is a sub-branch of Chicago. Also, G W Morris, of Omaha sales office, retired Jan 31. G D Jackson succeeds Morris as electrical division representative.

Magnus Chemical Co Inc, Garwood, N. J., acquires full control of American K.A.T. Corp. All functions of American K.A.T. will continue, with the manufacture of "K.A.T." and main office of American K.A.T. Corp henceforth located at Garwood, N. J. J D Holmes, in addition to continuing as general manager of marine and power-plant service div, Magnus Chemical Co, succeeds Michael Stone as president of American K.A.T. Corp.

T J Roberts has been named Houston district manager of **Johns-Manville** Industrial Products Div. He will supervise sales in Texas and parts of Louisiana, Arkansas and Oklahoma. Henry G Palmer has replaced Roberts as Atlanta district manager and will supervise sales in Georgia, Florida, Alabama, South Carolina and parts of Kentucky, Mississippi, North Carolina, Tennessee and Virginia.

Plibrico Jointless Firebrick Co announces appointment of Cody R Beane as manager of Plibrico Sales & Service Co, Charleston, W. Va. Beane succeeds the late Joseph S Stanley. Also, Frederic L Ruoff, ME, will maintain offices in Fort Wayne and South Bend, Ind., as manager of Plibrico Sales & Service Co in that area.

J M Spangler has been elected president of National Carbon Div of **Union Carbide & Carbon Corp,** New York City.

Pelton W Ellis is named manager of refining equipment div of **Penbody Engrg Corp,** New York City.

Marley Co Inc, Kansas City, Kan., assigns James W Elizardi to its Houston sales office as manager.

Ventilator div of **Swartwout Co** now shares the company's New York City branch office, **103 Park Ave, with the** firm's steam specialties div. Frederick Rickmeyer is in charge, filling vacancy created by death of Percy Jones. Eugene Rogers assists Rickmeyer in ventilator sales engineering.

Superior Engine Div, National Supply Co, has made John J Fetsko Jr regional manager in charge of all inland waterways diesel sales. Fetsko will have his headquarters in Boatmen's Bank Bldg, St. Louis, Mo.

American Machine & Metals Inc announces establishment of a new division through the acquisition of Gotham Instrument Co, New York.

Briggs-Weaver Machy Co, 300 S Wayside Dr, Houston, Texas, is chosen distributor in Houston and surrounding area for **Republic Rubber Div,** Lee Rubber & Tire Corp. Also T W Marx joins the division as sales representative in the Pacific North-

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Lowest Power Costs!!
INSIST ON
TODD BURNERS
-GAS OR OIL
Whether you burn gas, oil or a combination, you'll be amazed how Todd Burners cut your fuel and maintenance costs . . . give you savings up to 10%, increased power capacity. For utmost economy in your boiler plant—let skilled Todd specialists, backed by 35 years of Todd experience, engineer your replacement of obsolete equipment or new installations.
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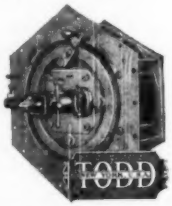
Gas Burners
Combination Oil and Gas Burners


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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Extending Condenser Tube Life By Reducing Fouling

Experience has shown that the life of condenser and heat exchanger tubing is often shortened because of localized attack brought about by foreign matter lodging within the tubes or deposited on the surface of the tube sheet or the tubes themselves.

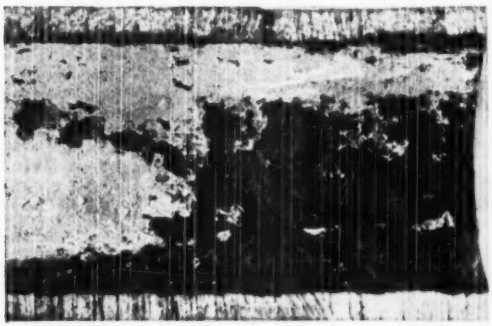
Much can be done, as a preventive measure, by using screens and strainers to keep foreign matter from condensers, heat exchangers and pumps but naturally screens have limitations. They cannot keep out marine growth and slime both of which may seriously injure condenser tubes. Also they cannot prevent corrosion-erosion of tubes when fine particles of sand are suspended in the water.

Operating Conditions Variable

The kinds of materials removed from the cooling water varies surprisingly from plant to plant even though separated by only a few miles. In some plants large rotating screens are in almost continuous operation. Other plants operate their rotating screens intermittently depending on seasonal runs of fish, leaves, branches, etc., brought in during and following periods of storm, high or flood water.

The kinds of debris which have been removed by screens, bars and strainers make an impressive list: fish, seaweed, grasses, leaves, branches of trees, shellfish, paper, nuts, bark of trees, stones, jelly-fish and all sorts of animal and vegetable matter.

The illustration shows impingement corrosion pitting that developed on the inside surface of an Admiralty tube. An object lodged in one side of the tube had caused turbulence. The full force of the circulating sea water was centered on this area while the opposite side was untouched because it was covered by the obstruction. Also other sections showed no appreciable deterioration. Some of the pits were so deep, however, that penetration of the tube wall had occurred in places.



Admiralty condenser tube attacked by impingement corrosion on the inside wall opposite an obstruction. The dark portion is the pitted area, the gray is a thin layer of protective film.

Alloys are available which are much more resistant than Admiralty to this type of attack—Aluminum Brass, Duronze IV (Arsenical Aluminum Bronze) and Cupro Nickel alloys. The individual merits of these alloys vary with the composition of the water.

Experimental work is in progress to ascertain the effect of high water velocities on these alloys. For low velocities in clean sea water impingement corrosion resistance of 70-30 Cupro Nickel containing ½% Iron is outstanding. Nevertheless, no alloy is invulnerable under adverse operating conditions.

Dangers From Foreign Matter

Some of the adverse effects are:

1. Blockage of condenser tubes by debris with marked reduction in heat transfer.
2. Under severe fouling conditions the unit may go "non-condensing" with loosening and leaking of condenser tubes in the tube sheets and warping of the tubes and tube sheets.
3. High back pressure due to restriction of flow by large masses of marine growth and debris damages pumps and associated piping.
4. Debris jamming of valves and/or restriction of flow through valves.
5. Inlet corrosion due to increased water velocity around the object lodged at the inlet. The amount of turbulence due to increased water velocity in the ends of open tubes also increases inlet end corrosion (impingement corrosion or erosion-corrosion) in these tubes.
6. Corrosion pitting or cracking initiated by decaying organisms and vegetation, particularly during periods of shutdown.

Maintenance Vital

Obviously the proper maintenance of screens, bars and strainers and periodic cleaning of condensers and heat exchangers are of the utmost importance to prevent fouling and excessive corrosion. The failure to do this is probably the greatest single cause of trouble in condensers and heat exchangers.

The time and expense involved in keeping screens, bars and strainers clean and in good operating condition may seem excessive yet all concerned with this matter are familiar with the kinds of trouble which have been prevented through the use of properly operating equipment.

Installations along the sea coasts require much ingenuity in the design of rotating screens and care in the selection of materials of construction in order to keep operating difficulties due to wear and salt water corrosion at a minimum. Due to the difficulty in anticipating the load of debris which may be encountered, it is hard to estimate the capacity of such equipment. The size of openings in screens should be small enough to stop all debris which cannot pass through the condenser tubes.

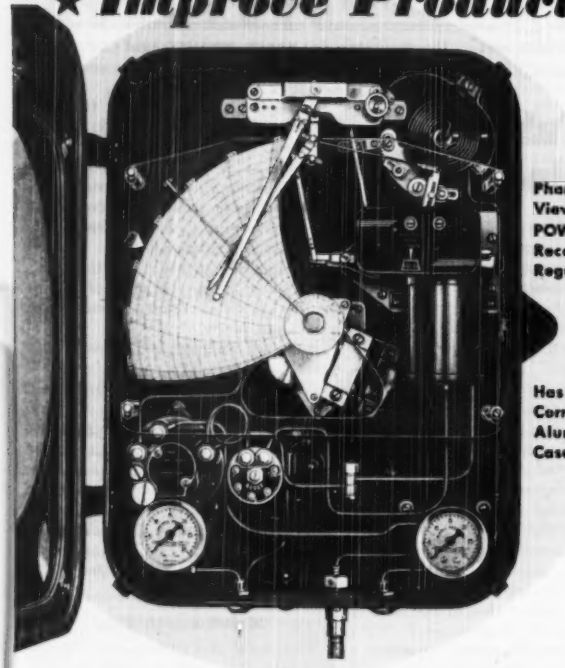
BRIDGEPORT BRASS

BRIDGEPORT BRASS COMPANY, BRIDGEPORT 2, CONN. • ESTABLISHED 1865

Mills at Bridgeport, Connecticut, and Indianapolis, Indiana • In Canada: Noranda Copper and Brass Limited, Montreal

(Advertisement)

★ REDUCE COSTS
★ Improve Production



Phantom View of POWERS Recording Regulator

Has Non-Corrosive Aluminum Case

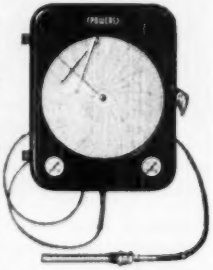
with precision control by—

POWERS

Air-Operated
INDICATING AND
RECORDING REGULATORS

For TEMPERATURE • HUMIDITY • PRESSURE

End losses caused by OVER-heating of processes or operations requiring precise control. Install POWERS pneumatic regulators. Their accurate control helps to improve quality of products—speed up production and save steam wasted by overheating.



Variety of Models: Recording Thermometers; Recording Regulators; Indicating Regulators; Wet and Dry Bulb Recording Regulators; Time Cycle Recording Regulators; Master and Sub-Master Indicating and Recording Regulators, etc. *Write for Bulletin 370.*

For Better Temperature and Humidity Control and valuable aid in selecting the right instruments for your requirements—phone or write our nearest office. There's no obligation. The Powers Regulator Co., 2771 Greenview Ave., Chicago 14, Ill. • 231 E. 46th St., New York 18, N.Y. • 1808 W. Eighth St., Los Angeles 5, Calif.

(102)

THE POWERS REGULATOR CO. • OFFICES IN 50 CITIES

west. Marx will headquarter in Portland and cover Oregon, Washington, northern Idaho and a portion of Montana.

M Russell Kambach has been promoted to advertising manager for **Aluminum Co of America,** Pittsburgh, Pa. J M Sharp has succeeded Kambach as assistant advertising manager.

Cutler-Hammer Inc has opened a sales office at 410 W First St, Dayton, Ohio. P L Erickson manages the office as a branch of the company's Cincinnati district office.

D M Berges is now chief engineer of Pesco Products Div of **Borg-Warner Corp,** in Bedford Township near Cleveland, Ohio.

Black, Sivalls & Bryson Inc designates Johnson Roney II, 608 Oak Ave, Clearwater, as the company's Florida representative.

Thomas O Moloney has been elected chairman of the board of **Moloney Electric Co,** St. Louis, Mo., to succeed the late Thomas O Moloney Sr. George J Kribs has been made treasurer.

O'Brien Industrial Equip Co, 1295 Folsom St, San Francisco, has been chosen sales representative for **Eriez Mfg Co.**

Pennsylvania Transformer Co, Canonsburg, Pa., names M L Manning development engineer. Boris Volgovskoy is now head of substation and regulator dept. Also, H J Schwarberg is sales representative in sections of Ohio and Kentucky. Schwarberg will work out of Cincinnati, Ohio.

C L Stocker has assumed sales and engineering responsibilities for **Lincoln Electric Co** in San Francisco area. Office for this district, located at 1303 Stanford Ave, Emeryville, Calif., has increased its welding engineering staff by addition of M F Yale and T Nichol. A L Patnik has been assigned to handle Seattle district with offices at 1914 Utah Ave.

Purolator Products Inc, Newark, N. J., elects Frank P Herman a member of the board of directors.

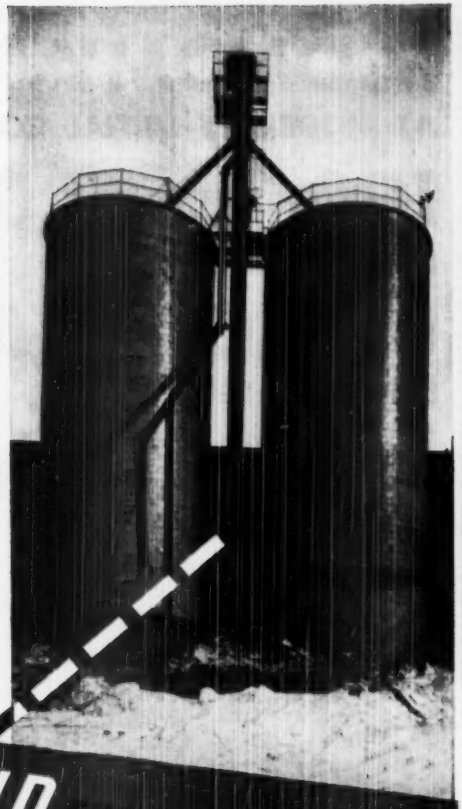
New York sales and engineering office of Syntron Co is now at 1860 Broadway, New York City.

E F Houghton & Co, Philadelphia, elects William F MacDonald president to succeed Major Aaron E Carpenter. MacDonald will temporarily continue to hold his office as treasurer. Carpenter is now chairman of the board but remains chief executive officer of the company.

Charles Calvin Christy is named assistant purchasing agent of **Laclede-Christy Co.** He succeeds B N Wright, who is being added to St. Louis district office.

Reliance Electric & Engrg Co announces opening of a sales office in Charleston, W. Va., located at 1206 Kanawha Blvd, East. William C McConnell is

here's how to improve your power plant operation this year . . .



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and see how you can gain new economies with FAIRFIELD Coal & Ash Handling Systems.

Every month, a big dollar entry goes into your overhead ledger for power plant operation. Any reduction in that overhead figure—more efficient and economical operation—means greater profits to you.

Your FAIRFIELD engineer can survey your present plant and make recommendations that will give you more efficient and economical operations at absolutely no obligation to you. Write or call today for an appointment with the FAIRFIELD engineer in your area.

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ECONOMY

AT MODERATE INITIAL COST

100 TO 4000

HORSEPOWER RANGE

600# GA., 750° F.

STEAM PRESSURES

MURRAY

STEAM TURBINES

TYPE UV MULTISTAGE

The Type UV Multistage Turbine is available in from two to ten pressure stages making Multistage steam economy available at moderate initial cost. Horsepower range is from 100 to 4000, steam pressures up to 600‡ ga., 750° F., condensing or non-condensing. Several governors and accessories adapt UV Turbines to practically any mechanical drive within the capacity range.

Pictured is a 5 Stage UV Turbine developing 325 HP at 6200 RPM operating condensing. Turbine is equipped with variable speed oil relay governor, pressure lubrication and vacuum breaker, and is in use driving a centrifugal compressor for refrigeration.

Contact your Murray representative for prices and engineering information or write for Bulletin T-122.

MURRAY IRON WORKS COMPANY

BURLINGTON, IOWA

BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

branch manager. Also, Jack H Eichler is added to Boston district office as field sales engineer. He will report to Leon M Dunning, district manager.

George A Dauphinais has been assigned works manager of **Quaker Rubber Corp,** Philadelphia, a newly acquired division of H K Porter Co, Pittsburgh.

U. S. Air Conditioning Corp, Minneapolis, names James R Logan vice-president in charge of manufacturing and engineering, and Merrill L Benson manager of coils and coil products div.

Nelson Equip Distributors, 913 Roosevelt Bldg, Indianapolis, is selected sales representative for **Automatic Transportation Co.** Territory to be served is state of Indiana, except for Porter, La Porte and Lake counties.

Whiton Machine Co has appointed W E Pearson Co, 306 Smith Tower, Seattle, its representative for state of Washington. T C Chown, Ltd, 1440 St. Catherine St, West, Montreal, Ont., has been chosen representative in Canada.

Glen Juergensen assumes duties of consultant and development engineer for Magnilastic Div of **Cook Electric Co,** Chicago. In the same division, Richard T Cahill becomes design and application engineer.

A O Smith Corp, Milwaukee, Wis., has contracted for new manufacturing and supply facilities with Whirl-A-Way Motors Inc, Tipp City, Ohio, manufacturing SMITHway fractional hp motors to specification. D L Mills, president of Whirl-A-Way, has been made Eastern regional sales manager of the motor div, with headquarters in Dayton, Ohio. Hal E Rowland, Dayton; J P Hoffberger, New York; and R O Dehlendorf, Chicago, will report to Mills. Sales in eleven Western states will be directed from Los Angeles plant, which will also supervise sales in the Southwest area under sales manager George H Nichols, with headquarters in Houston, Texas.

Harrison Welch becomes western division service manager for **Caterpillar Tractor Co.** Welch is replaced by D L Lammers as eastern division service manager. T R Farley is named general manager of the company's new plant to be located two miles southwest of Joliet, Ill.

California sales division of **Sylvania Electric Products** is reorganized into two separate divisions: (1) Central Pacific div, headquarters in San Francisco, Robert C Harper, division sales manager; (2) South Pacific div, headquarters in Los Angeles, Charles I Brady, division sales manager. Northwestern div, headquartered in Seattle, will remain in operation to service that section of the country.

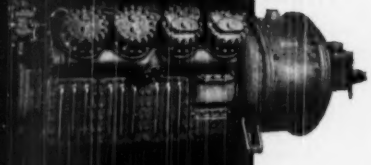
Alloy Steel Products Co appoints following concerns distributors: Republic Supply Co, at 1401 Park Ave, Emeryville, and 2600 S Eastland Ave, Los Angeles, Calif.; Railway & Power Engrg Corp, Ltd, 169 Eastern Ave, Toronto, Ont., Canada. Wetzel

IN AIR CONDITIONING
it's the
COMPRESSOR THAT COUNTS

UNIT AIR CONDITIONERS

...OR COMPRESSORS

TO 100 hp.



ONLY WESTINGHOUSE
CAN GIVE YOU THIS RANGE
-HERMETICALLY-SEALED

Since 1933, Westinghouse has pioneered the hermetically-sealed compressor design in air conditioning. Today *only* Westinghouse can offer you this successful principle in *all* of its models, backed by 17 years of successful installations.

The Westinghouse Hermetically-Sealed Compressor is your guarantee of years of economical, trouble-free service. There are no belts to break or pulleys to adjust, no shaft seal refrigerant leaks. Reduced size and modern design lessen vibration and noise. Entirely enclosed in a steel shell, its refrigerant-cooled motor requires no ventilation and is protected from dirt, dust and moisture.

Whether you are considering a self-contained unit or a complete system, the compressor will make the difference. By choosing Westinghouse, you are assured of the benefits of hermetic sealing in *every* size. Sturtevant Division, Hyde Park, Boston 36, Mass.

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FIRST to introduce
HERMETICALLY-SEALED
COMPRESSORS IN
AIR CONDITIONING

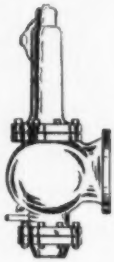
Problem-Corroded, plugged-up,

Solution-BS&B SAFETY HEADS!

BS&B SAFETY HEADS are the answer to your relief valve problem. These precision devices give extra protection to relief valve operation. They can be used: (1) Under your existing relief valve (2) As secondary relief devices (3) As sole pressure relief devices (4) At outlet of certain types of relief valves.

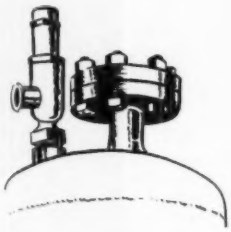
1. *Under your existing relief valve*

A SAFETY HEAD under your relief valve isolates the valve from vessel contents. Leakage through the valve is halted until the SAFETY HEAD rupture disc is burst by over-pressure. For this use a bleed line must be installed in the chamber between the valve plug and the rupture disc, enabling the operator to determine if rupture disc is intact.



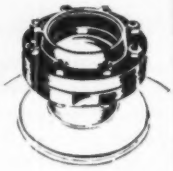
2. *As a secondary relief device*

. . . when operation is close to the relief valve setting. As a secondary relief device, the rupture disc can be rated much higher than the valve setting. If the valve fails to function or capacity inadequate you are certain of positive protection when pressure rises to the predetermined bursting pressure of the disc.



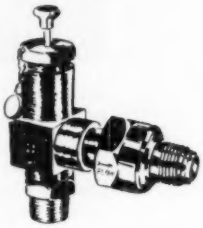
3. *As sole pressure relief device*

This installation is used when it is necessary to have a shut-off or when materials handled are not toxic or flammable.



4. *At outlet of certain types of relief valves*

A SAFETY HEAD at the relief valve outlet will stop leakage until pressure builds up to the designed bursting pressure of the rupture disc. In this use the valve design must not permit an increased pressure setting of the valve due to pressure in the chamber between the rupture disc and the valve plug. Not recommended where corrosive or viscous materials might contaminate internal parts of the valve.



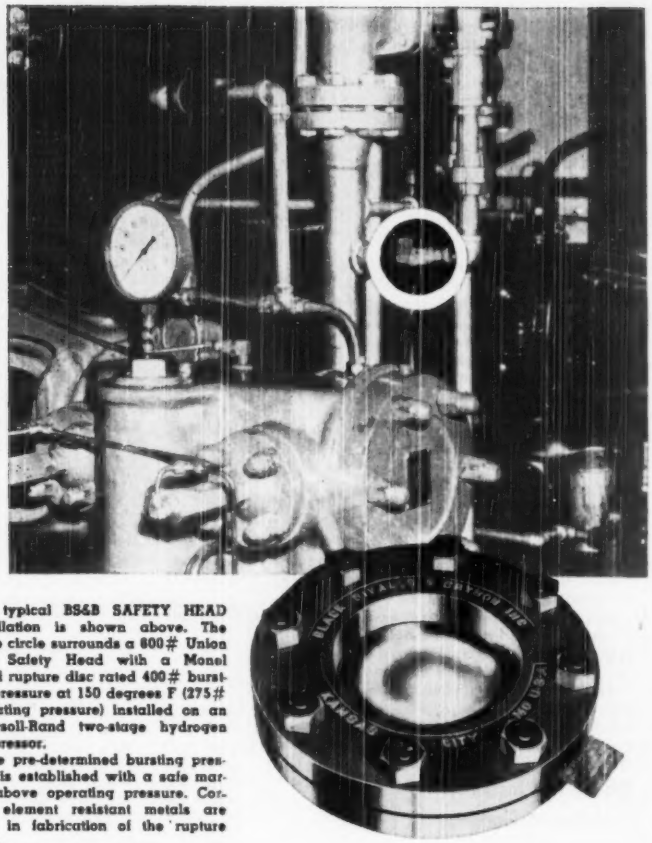
Now—New Catalog!

It's now being prepared . . . the new BS&B SAFETY HEAD catalog. Gives you all the facts . . . all the answers to your questions about these amazing safety devices. Reserve your copy now by mailing the coupon on opposite page!

FREE ANALYSIS!

Jim Myers, SAFETY HEAD Sales Manager will have a BS&B engineer analyze your pressure relief problems and submit suggestions to you WITHOUT COST OR OBLIGATION. Mail the coupon on opposite page or call GRand 6700, Kansas City, Mo. Do it now!

leaky relief valves...



A typical BS&B SAFETY HEAD installation is shown above. The white circle surrounds a 600# Union type Safety Head with a Monel metal rupture disc rated 400# bursting pressure at 150 degrees F (275# operating pressure) installed on an Ingersoll-Rand two-stage hydrogen compressor.

The pre-determined bursting pressure is established with a safe margin above operating pressure. Correct element resistant metals are used in fabrication of the rupture discs.

BS&B SAFETY HEADS are rapidly becoming standard installations on compressed gas and air equipment. Once the complete BS&B SAFETY HEAD story is understood... for unfailing protection to both property and the lives of personnel... there is little delay in order placing. Investigate BS&B SAFETY HEADS at once.

Safety Head Dept.
SPECIAL PRODUCTS DIVISION
Black, Sivalls & Bryson, Inc.

BLACK, SIVALLS & BRYSON, INC.,
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☐ Please reserve for me a copy of the new BS&B SAFETY HEAD catalog.

☐ Please have a BS&B SAFETY HEAD engineer analyze my relief problem, without cost or obligation to me.

Name_____
Firm_____
Title_____
Address_____
City_____ Zone____ State_____

BS&B SAFETY HEADS

Equip Agency, 375 S W Temple, Salt Lake City, Utah, is manufacturers' agent covering territory of Utah, southern Idaho, Wyoming and Colorado.

Bridgeport Brass Co has moved its warehouse facilities from Newark to Hillside, N. J. N H Mosher, district manager, is in charge.

John M. Cochrane is now chief engineer at Hampden steam plant of **Western Massachusetts Electric Co.** Russell D Purrington becomes assistant chief engineer at new West Springfield station.

R G Rincliffe has succeeded N E Funk, who retired, as director and executive vice-president of **Philadelphia Electric Co.**

Stone & Webster Engrg Corp, Boston, elects Lockwood J Towne and Karl Finsterbusch, of New York, and T Cortlandt Williams, of Boston, to its board of directors.

Charles B Belknap, Owens-Illinois Glass Co, is elected to board of directors of **Arthur D Little Inc,** Cambridge, Mass., research and engineering organization.

Ford, Bacon & Davis, engineers-constructors, names Thomas I Crowell Jr and Charles B Cooke vice-presidents.

Valve Manufacturers Assn has elected the following officers: *President*—W B Holton Jr, president, Walworth Co; *vice-presidents*—Ernest Cochran, vice-president, Chapman Valve Mfg Co, Charles W Burrage, secretary, Lunkenheimer Co, and Wayne Young, president, Ohio Injector Co; *secretary-treasurer*—George A Cooper, New Rochelle, N. J.

Dr Hamnett P Munger is appointed by **Battelle Memorial Institute** to coordinate its air-pollution research activities and to act in a liaison capacity between Battelle and industry.

OBITUARIES

Harry Sanford Brown, chairman of the board and president, Foster Wheeler Corp, died suddenly Feb 18 while on a voyage to South America.

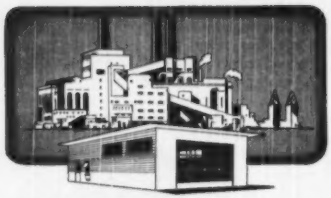
J E S Thorpe, president of Nantahala Power & Light Co, a subsidiary of Aluminum Co of America, died Feb 24 in Franklin, N. C.

Carl G Naylor, 70, founder and president of Naylor Pipe Co, Chicago, died suddenly Feb 13.

William Carey Taylor, 57, North Carolina representative for New York & New Jersey Lubricant Co, died Feb 5 at his home in Greensboro, N. C.

Frederic Alan Schaff, 65, chairman of the board, Combustion Engrg-Superheater Inc, died Feb 7 at his home in Bronxville, N. Y., following a protracted illness.

Beaumont Birch Co has enlarged its line of coal-, coke- and ash-handling equipment to include hydraulic materials-handling equipment.



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Whether your equipment serves a city of millions, a small town, or just your own plant, ISC can solve the noise problem quickly and inexpensively. Investigate today.

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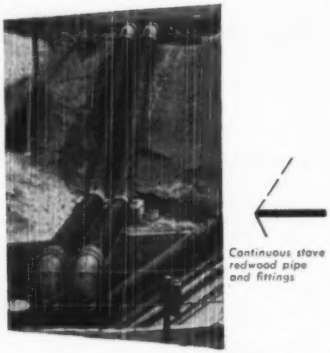

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TVA's Power Load Hits New Highs in 1949

The Tennessee Valley Authority generated 15,734,764,000 kwhr during the fiscal year 1949, ended last June 30, and chalked up power revenues of $58 million, TVA's annual report disclosed.

Aided by good water conditions, hydroelectric production for the year was 13,285,649,000 kwhr, up 1,666,945,000 from 1948. Steam plants, on the other hand, produced only 2,449,115,000 kwhr, slightly less than the previous year. Including 234,750,000 kwhr purchased from interconnected systems and 1,166,827,000 kwhr received in interchange, TVA's power total was 17,136,341,000 kwhr.

Peak hourly demand for the area during fiscal 1949, was 2,419,900 kw, a jump of 285,000 over 1948. Including deliveries to utilities outside the service area, the figure was 2,666,000 kw, an increase from 2,457,500 kw the previous year.

During the fiscal year the Authority added seven units with a combined capacity of 190,800 kw, compared with a net increase in installed capacity of only 52,000 kw for the entire three years previous.

Biggest addition during fiscal 1949 was 36,000 kw at the Army Engineers' Dale Hollow Dam on the Cumberland River. This power was sold by the Department of Interior. TVA will get an additional 450,000 kw by the end of 1952 from two other Cumberland dams now under construction, Center Hill and Wolf Creek.

In all, the 1949 report looks to the addition of 1,200,000 kw during the next three years. It will come from the Cumberland dams, the new 375,000-kw Johnsonville steam plant, and the addition of 390,000 kw in new hydro capacity at TVA dams.

Installed capacity of the system on June 30 was 2,747,092 kw. By the end of 1952, it is expected to reach 3,959,160 kw. Not included in these figures is the 250,000-kw Widow's Creek steam plant, which Congress will be asked to approve early in the new session of Congress.

Australia to Install First Kaplan Turbines

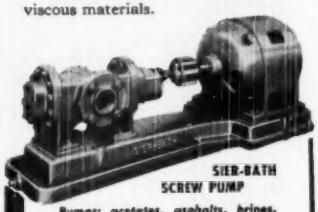
Construction work on the new 50,000-kw hydro unit at Hume Reservoir in Australia is scheduled to begin in April. Bids for the generating plant closed in January. Located on the border of New South Wales and Victoria, the new station will divide its power between the two states.

Two 25,000-kw kaplan turbines will be installed, a design not previously used in Australia. Engineers of the State Electricity Commission of Victoria, the construction authority, inspected kaplan turbines in Sweden and elsewhere before the decision was made. The kaplan unit with its automatically adjustable blades is particularly suited to this project because of its wide variations of water flow and operating head, from 50 to 105 ft.

Another feature of the power-station design, influenced by U.S. practice, is the elimination of the superstructure, except the overhead traveling crane necessary to handle the turbine and generator parts.

SIER-BATH SCREW PUMPS solve the toughest Pumping Problems!

Take a tough, sticky pumping problem — add powerful Sier-Bath Screw Pumps—and you've got the recipe for a smooth-flowing operation! Simple design (only two moving parts), and sturdy but accurate construction are Sier-Bath's formula for efficient, low cost moving of viscous materials.



SIER-BATH SCREW PUMP

Pumps: acetates, asphalts, brines, Bunker C fuel oil, cellulosics, greases, molasses, syrups, etc. Pressures up to 1000 lbs.

These Features Cut Maintenance Costs:

1—*No metallic contact between rotors* sustains high volumetric efficiency, even when handling non-lubricating liquids.

2—*High volumetric efficiency* reduces wear caused by erosion.

3—*Axial Flow from ends to center* eliminates thrust bearings, high radial loads, pulsation, vibration.

4—*Only suction pressure on stuffing box*—packing can be added while pump is running.

5—*Heavy duty service* from husky shafts, sturdy rotors, high load capacity bearings, and deep stuffing boxes.

Available in horizontal or vertical construction—special alloys, jacketed bodies to meet individual requirements. Write for booklet.

ALSO MANUFACTURERS OF "GEAREX" ROTARY PUMPS, PRECISION GEARS, and GEAR COUPLINGS.

FOUNDED 1905 MEMBER A.G.M.A.

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43 GEARMOTORS drive series of 3 Conveyors..

...at Benwood Works of Wheeling Steel Corp.

This interesting installation is typical of the versatility and efficiency of Philadelphia GearMotoR applications . . . It consists of 43 2 h.p. units operating from "Reliance" 30 V*S Drives to provide speeds that vary from 50 to 500 r.p.m. The Philadelphia GearMotoR is used by hundreds of companies throughout industry because: It is a self-contained, extremely compact unit that conforms to recommended standards of A.G.M.A. and N.E.M.A.; it is available in single, double and triple reductions (range of speeds run from 780 through 7.5 r.p.m.;) motor rating from 1 h.p. through 60 h.p. . . . A-c or D-c Motors are precision-built and fit perfectly with gear unit. Gears are helical type, (long-lived and quiet) and made of quality alloy steel, precision machined (teeth shaved) and induction-hardened. Assembly is very simple: Motor and gear units are each self-contained, yet readily separated; gears in multi-reduction units may be inspected without uncoupling from driven machine. Lubrication is of positive "splash type," with large reservoir. Gear housing is leak-proof, and motor (which is greased independently) has double-shielded ball bearing design.

Send for 42-page illustrated catalog, and please use your Business Letterhead when requesting it.

Philadelphia Gear Works, INC.

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NEW YORK • PITTSBURGH • CHICAGO • HOUSTON
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CONNECT WITH THESE ADVANTAGES IN YOUR PIPING CONNECTIONS . . .

- ★ Walls of Uniform Thickness
- ★ Smooth Inner Surfaces
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GLOBE PRECISION PROCESS SEAMLESS WELDING FITTINGS

All of these advantages are yours in Globe Welding Fittings. Globe's metallurgical experience and highly specialized production and processing facilities are utilized beginning with the production of Globe seamless steel tubes and continuing through every step to the finished Globe Welding Fittings.

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Producers of Globe seamless stainless steel tubes — Gloweld welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe Welding Fittings.

There's plus value in Globe Welding Fittings — send for the catalog.

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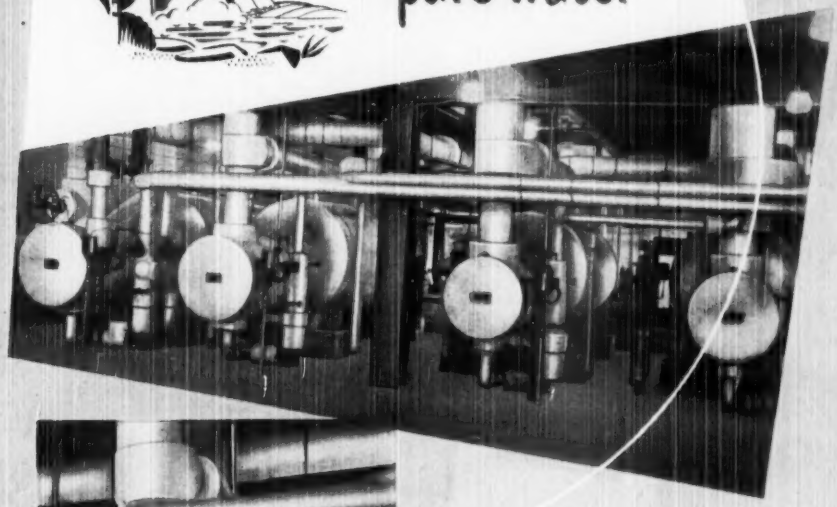
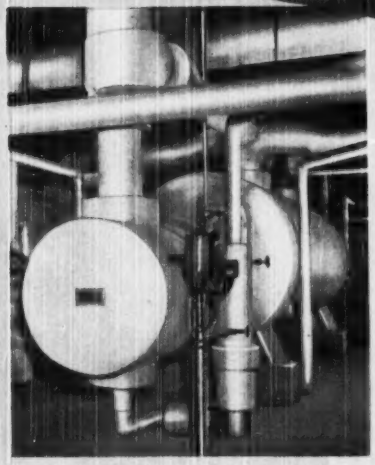
Water Evaporators

FOR A DEPENDABLE SOURCE
OF
pure water





THIS four effect water evaporator installation is in the plant of the Eastman Kodak Company, where it replaces a large number of small single effect "stills"

The result of this installation has been a larger supply of uniformly pure water, appreciably better than previously available, with materially lower production costs. This is an important item in a plant with a heavy demand for extremely high-purity water.

Struthers Wells Water Evaporators are available in several different designs, and in a wide range of sizes, for handling any type of raw water and producing uniformly pure distillate.

Write for further information.

STRUTHERS WELLS CORPORATION

Process Equipment Department . . Warren, Pa.

PLANTS AT WARREN, PA. · TITUSVILLE, PA. **OFFICES IN PRINCIPAL CITIES**

A NEW REFRIGERATION CONDENSERS BOOKLET BY Vogt

Write FOR BULLETIN RC-1

Here's pertinent, up-to-the-minute information on our complete line of refrigeration condensers . . . a 24 page booklet showing types and sizes designed to deliver low temperature liquid with the lowest condensing pressure.

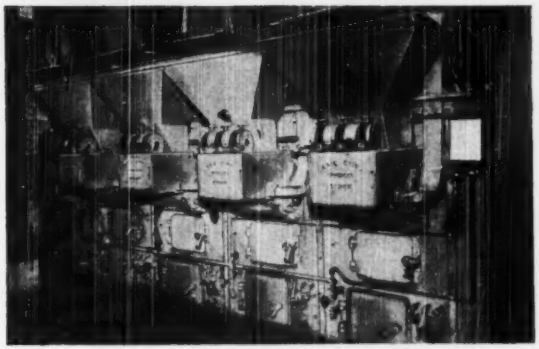
Vogt Refrigeration Condensers are fabricated from top quality plates, tubes, pipes, forgings, and castings by skilled workmen in modernly equipped shops. Units are designed, tested and stamped to A.S.M.E. Code requirements.

Vogt FOR BETTER REFRIGERATION

HENRY VOGT MACHINE CO., LOUISVILLE 10, KY.

BRANCH OFFICES: NEW YORK, PHILADELPHIA, CLEVELAND, CHICAGO, ST. LOUIS, DALLAS

For a SPREADER STOKER *Consult* ERIE CITY



Erie City Spreader Stoker firing Erie City 50,000 pounds per hour boiler in a mid-western chemical plant.

—a manufacturer, for over 100 years, of steam generating equipment. This long experience with boilers of all types and capacities particularly qualifies Erie City to build stokers. This Erie City Spreader Stoker burns a wide range of coals efficiently and economically. For complete details

Write for Bulletin **SB-31** ➡

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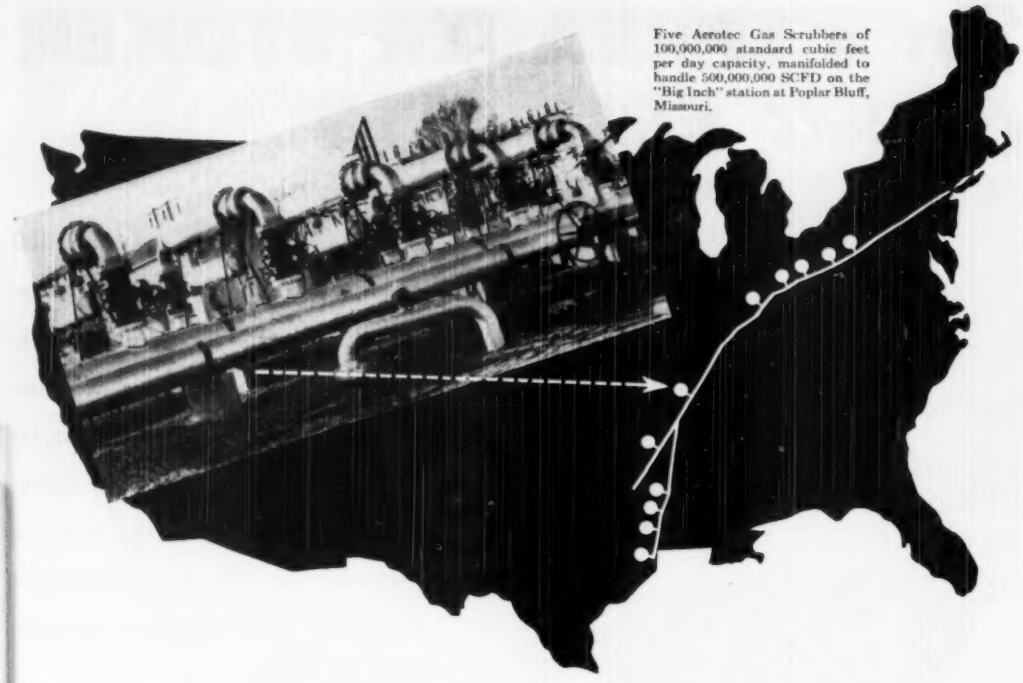
Complete Steam Generators • Type C 3-Drum Boilers • Type VL 2-Drum Boilers • The "Economic" Boiler with or without Water Walls • Welded H. R. T. Boilers • Welded Steel Heating Boilers • Coal Pulverizers • Underfeed and Spreader Stokers • Welded Pressure Vessels for the Process Industries.

ERIE CITY IRON WORKS • ERIE, PA. • *Since 1840*



Five Aerotec Gas Scrubbers of 100,000,000 standard cubic feet per day capacity, manifolded to handle 500,000,000 SCFD on the "Big Inch" station at Poplar Bluff, Missouri.

THE INDUSTRY SPECIFIES:

AEROTEC *Dry* GAS SCRUBBERS

On the "Big Inch" pipeline and at the wells, Aerotec Gas Scrubbers are performing with unparalleled efficiency the job of keeping pipelines free of dust, liquid and distillates.

Based on a dry process of separating foreign material from gas, the Aerotec method eliminates the need for a cleaning medium, insures a minimum carryover of foreign matter into the gas stream. Units are available in practically any size up to 100,000,000 SCFD. Larger capacities may be handled by manifolding these standard units to any desired capacity.

Acceptance of Aerotec Gas Scrubbers is best demonstrated by the rapidly growing list of new users. Repeat orders prove that the Aerotec method is setting a new standard for an industry where maximum efficiency is required.

Complete information on this new method is now available.
Write for Catalog 501-2W today!

Project and Sales Engineers

THE THERMIX CORPORATION

Greenwich, Connecticut

(Offices in 28 Principal Cities)

Canadian Affiliates: T. C. CHOWN, LTD., 1440 St. Catherine St., W., Montreal 25, Quebec

THE AEROTEC CORPORATION

GREENWICH, CONN.

THE ANCHOR PACKING COMPANY

PRESENTS

Chrome Lock

NEW

Adhesive Backed, Impregnated Felt Gasketing . . .

For corrosion proof, water, air and dust tight sealing of all faying surfaces such as lapped, butted or flange type joints.

Chrome Lock gasketing material consists of a high grade felt containing wool, impregnated to adhere to metal, glass, wood, concrete and plastics. Stays put on vertical or inverted surfaces. No odors. Non toxic. No clean-up. Has cut application man hours and over-all gasketing costs upwards of 50%.

Chrome Lock maintains continued pliability and does not embrittle with age or under heavy pressure. Acts as a cushion, prevents leaks due to vibration and shock, because, under pressure, Chrome Lock extrudes a thin protective coating onto the faying surfaces.

Chrome Lock is available in rolls, tapes and stamped. *Four thicknesses:* 1/32", 1/16" (100'), 1/8" (50') and 1/4" (25'). *Any width* from 3/16" to 66".

Contact our nearest Branch Office for color folder describing Chrome Lock.

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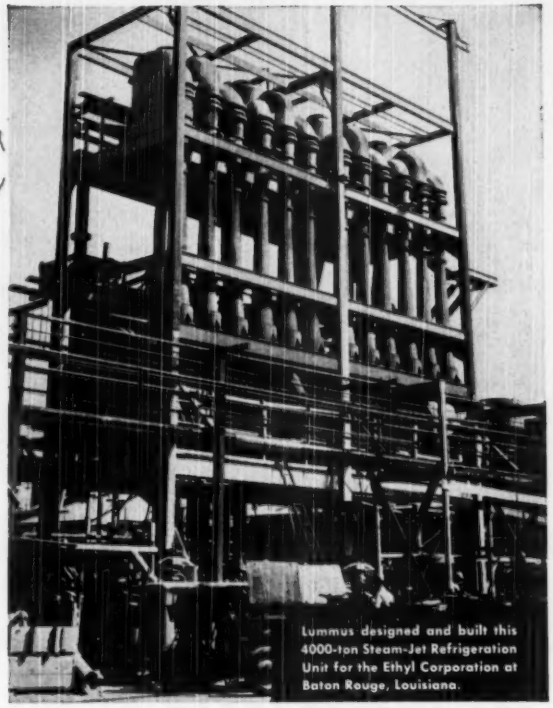
FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE

WORLD'S LARGEST

steam-jet refrigeration unit



Lummus designed and built this 4000-ton Steam-Jet Refrigeration Unit for the Ethyl Corporation at Baton Rouge, Louisiana.

No similar unit as large as this 4000-ton giant had ever been operated before, but Lummus' record of achievement and heat-transfer engineering experience won the contract.

The unit provides a dependable, low-cost supply of chilled water. Like all Lummus steam-jet refrigeration units, it has these operating advantages:

- *no expensive refrigerant replacement*
- *no moving parts to replace*
- *low maintenance cost*
- *simple operation*
- *long service life*

Lummus steam-jet refrigeration units are used to chill water for air conditioning systems and for petroleum, chemical, and other industrial processes. These units operate with minimum quantities of steam and condensing water, utilizing either exhaust or live steam and do not require specially treated make-up water.

Whether your refrigerating requirement is in tens or thousands of tons, you can get a dependable, economical steam-jet unit engineered for the job by Lummus. Many standardized units are available to meet a wide range of requirements. If your problem is a special one, Lummus engineers have the knowledge and experience to help solve it.

THE LUMMUS COMPANY
Heat Exchanger Division
250 West 14th Street, New York 11, N. Y.

LUMMUS

Atlanta • Boston • Chicago • Cleveland
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Write for illustrated bulletin

We shall be glad to send you a copy of a publication containing 16 pages of design data, illustrations, and diagrams of heat transfer equipment. Ask for Bulletin M-303.

LOOK TO LUMMUS for Steam Surface Condensers • Evaporators • Feed Water Heaters • Boiler Blowdown Heat Exchangers Steam Jet Air Ejectors • Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers • Process Condensers • Reboilers Steam Generators (Indirect Fired) • Fuel Oil Heaters • Lubricating Oil Coolers • Pipe Line Coolers • Jacket Water Coolers

BEACON COAL

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Where temperature control is a must

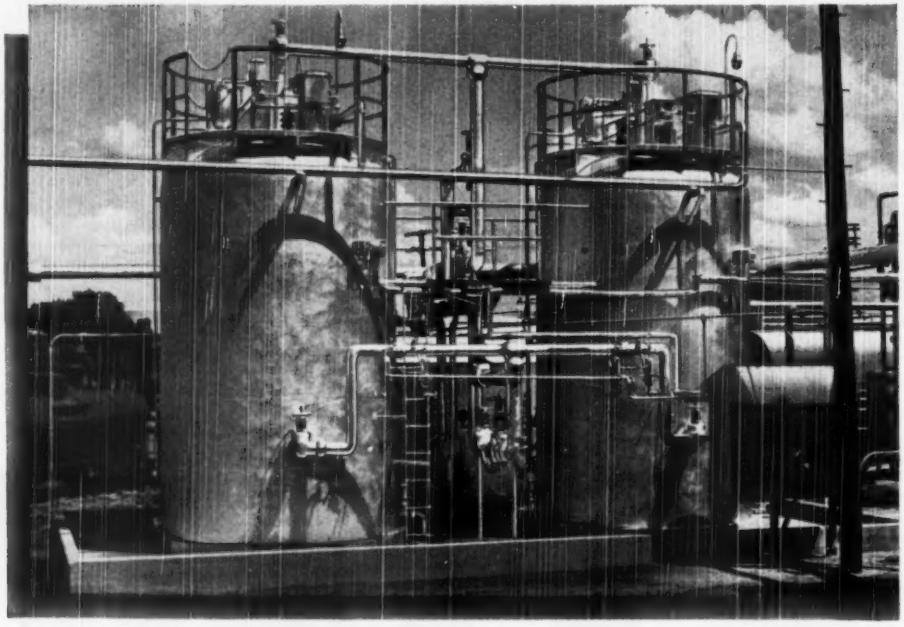
K&M "FEATHERWEIGHT" 85% MAGNESIA INSULATION

When your problem is complex . . . when you need the answer to accurate temperature control and high insulation value . . . you can depend on K&M "Featherweight" 85% Magnesia to take its full share of responsibility.

This dependable heat insulation assures high non-conductive efficiency that lasts. Its advantages come from the scientific K&M method of compounding clean asbestos fiber with basic carbonate of magnesia, in correct proportions—with proper distribution. The result is lightweight pipe and block insulation whose structural strength contributes to application and maintenance savings.

"Featherweight" 85% Magnesia, available in all standard dimensions, is one of the many types of insulation produced by K&M. Investigate them by obtaining full data and expert information from your nearest K&M Distributor.

Owner: Midland Cooperative Wholesale Refining Co., Cushing, Oklahoma.
Equipment: Desalters and Piping. ***Contractor:*** Armstrong Cork Co.
Insulation: K&M "Featherweight" 85% Magnesia—Weatherproofed.



Nature made Asbestos...
Keasbey & Mattison has made it serve mankind since 1873

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA
In Canada — ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG and VANCOUVER

Zallea Expansion Joint News

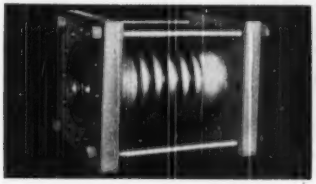
PUBLISHED BY ZALLEA BROTHERS—WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

Expansion Joint of the Month

Why Zallea Joints Last Longer

HIGH PRESSURE TOROIDAL TYPE

Often we are called upon to design and build expansion joints for special applications which require extreme pressure or temperature service. Recently a large manufacturer had a problem involving testing of classified aeronautical equipment and called on us. After careful analysis of operating conditions, our engineering staff developed high-pressure toroidal stainless steel expansion joints for use on a 700 lb. liquid oxygen service line, operating at minus 320° F. All materials of this special unit, including the



flanges and rods, are of stainless steel for dependable operation at extremely low temperatures. The handling of this unique problem might suggest a possible answer to the expansion problem you now face. For many years, our concentration upon the manufacture of *one* product only—expansion joints—has resulted in the gaining of special skill and broad experience, which enables us to offer you *qualified engineering* service and *unexcelled products*. At all times, we welcome your inquiry.

. . . a complete, practical catalog on all Zallea Expansion Joints. A text book and a valuable reference source. Send for your *free* copy *today!*

ZALLEA BROTHERS, 814 Locust Street
Wilmington 99, Delaware.

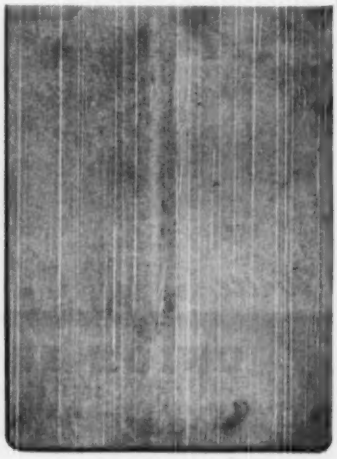
FREQUENTLY we are asked why our stainless steel expansion joints stand up where others have failed. There are several reasons, but *one* important factor involves the pickling and passivating process we employ in the *controlled* manufacture of all our joints. After final heat treatment, all scale is removed by pickling in several acid baths, followed by passivating. Scale formed during annealing will rust, and if not removed, will cause corrosive attack and pitting of the metal itself.

Test Shows Why

The unretouched photographs below illustrate the importance of scale removal. Two strips were cut from the same sheet of stainless steel. Both were annealed. Surface scale, which resulted from this operation, was allowed to remain on one sample while the other was pickled and passivated. Both samples were then exposed to the weather for a period of only ten days! Note the result: the *untreated* sample on the left is completely covered with rust, while the other is as clean as the moment it left the acid bath. Consider this important factor in the expansion joints you buy, for a rusted joint—*even before installation*—is well on its way to early failure. Call our nearest representative and he will show you similar samples.

Controlled Manufacture

Extra care in pickling and passivating all stainless steel expansion joints is standard practice with Zallea. Temperatures, concentration of the acids, and the length of pickling time are carefully controlled. Finally, after several pickling operations, the stainless steel expansion joints are passivated in nitric acid to produce a surface which is in the best condition to resist corrosion. Such care in *controlled* manufacture results in the Zallea Expansion Joint as many know it—durable, dependable, and maintenance free. When you want to be *sure*, always specify ZALLEA.



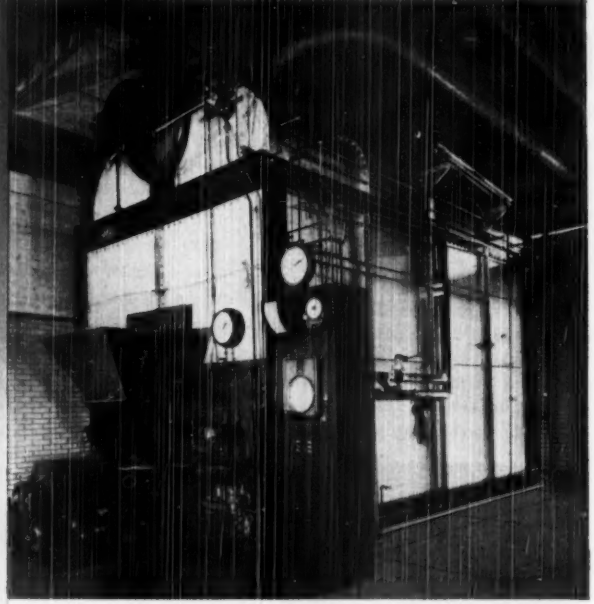
Advertisement

UNION "S" STEAM GENERATOR

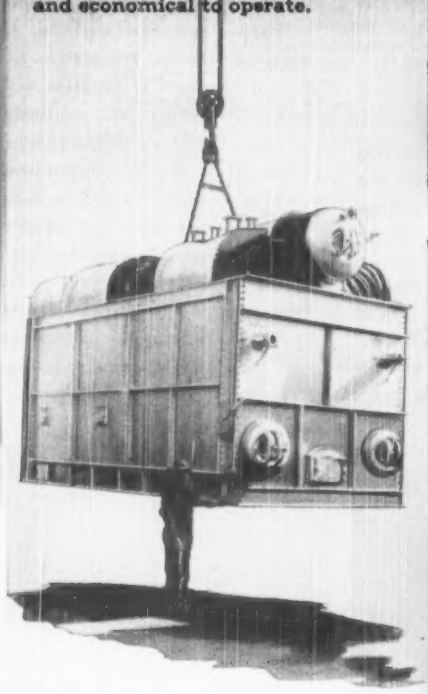
WATER COOLED FURNACE . . . SHIPPED ASSEMBLED

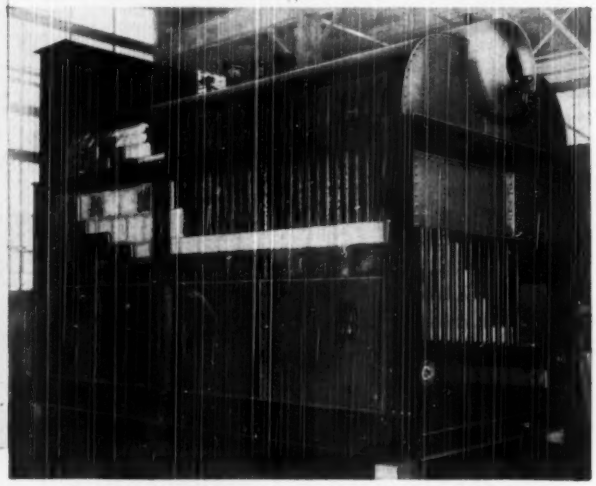
Change your dingy boiler room into a show spot.

This compact Union "S" Steam Generator with its completely steel clad, insulated setting and streamline appearance is as efficient as it looks. You'll be surprised how little floor area and height is required. You can profit from efficient furnace cooling and adaptability to low grade fuels. Its large water holding capacity, its rapid and positive circulation make it extremely safe and economical to operate.



This large tool manufacturer knows that it pays to use modern machines, so why not a modern power plant? He has it in the Union "S" Steam Generator.





Union "S" Steam Generator being assembled—note side and top wall construction—fire clay tile—block insulation and steel casing.

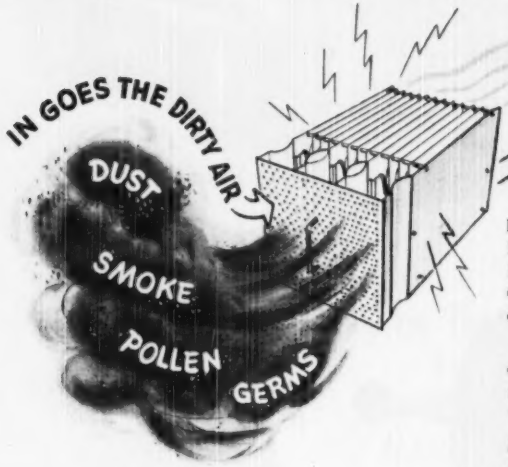
Write FOR BOOKLET 119

UNION IRON WORKS . . . *Since 1890*

1091 CASCADE STREET • ERIE, PENNA.

BOILERS • PROCESS EQUIPMENT • FABRICATED STEEL

AIR-MAZING FACTS about ELECTROMAZE —a new, improved way to filter air electrically



Here's a new type of electric air filter for stores, restaurants, hospitals, offices and other commercial and industrial establishments. Electromaze rids the air of smoke, pollen and invisible dust particles as small as 1/250,000 of an inch. Gives employees new comfort on the job. Keeps customers coming back. Holds cleaning bills to a minimum.

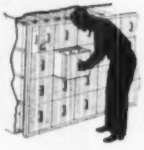
Electromaze gives you many exclusive features that increase operating efficiency and simplify layout, installation and maintenance. See your nearby Air-Maze representative or write Air-Maze Corporation, Cleveland 5, Ohio.

P. S. When planning improvements in air filtration be sure to call in your consulting engineer. His lifetime experience is yours for the asking. And you can act on his recommendations with confidence.

ONLY ELECTROMAZE GIVES YOU ALL THESE BIG IMPROVEMENTS!

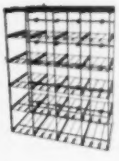
"FILE DRAWER" DESIGN

Cells slide in and out of frames like file drawers—automatically make or break electrical connection. Can instantly be removed for inspection, servicing or replacement.



"BUILDING BLOCK" INSTALLATION

Treated steel frames bolt together in a jiffy to form banks built like a skyscraper. Your choice of any combination of cells 4" x 12", 8" x 12" or 12" x 12" permits installation in restricted spaces.



EASIER SERVICING

"File drawer" cells may be cleaned while in place with ordinary city water pressure

or

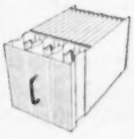
where no drain or water connection is available, cells may be quickly removed, cleaned and oiled in separate tank.

DUAL IONIZATION

Two ionizing wires instead of one insure maximum charging of dirt particles. Double protection in case of wire breakage. Smaller diameter wire practically eliminates dirt build-up, insuring maximum efficiency at all times.

IONIZER AND COLLECTOR IN SINGLE CELL

Use of a single high voltage in both ionizer and collector permits unitized construction. Each cell is a complete filter in itself. All-aluminum plate construction resists corrosion—reduces weight.



SELF-ADJUSTING POWER SUPPLY

Automatically compensates for normal line fluctuations, minimizes normal spark-over occurence. Maintains optimum filtering efficiency. Provides full protection against even a complete short circuit.

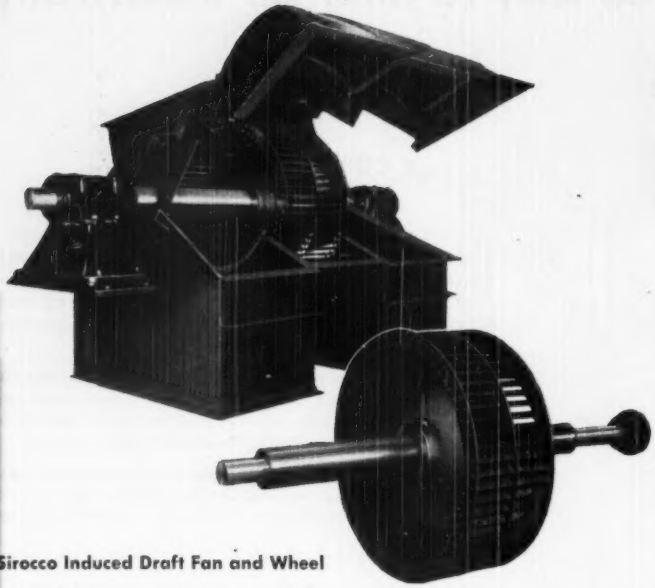
AIR FILTERS
SILENCERS
SPARK ARRESTERS

AIR-MAZE
THE FILTER ENGINEERS

LIQUID FILTERS
OIL SEPARATORS
GREASE FILTERS

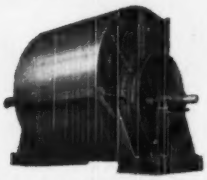
SIROCCO INDUCED DRAFT FANS

Standard of the World

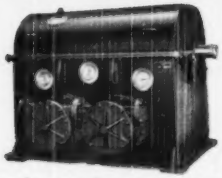


Sirocco Induced Draft Fan and Wheel

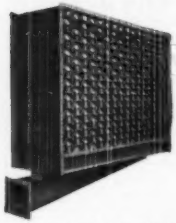
Heavy Duty Coils



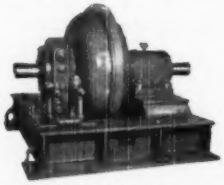
American HS Forced Draft Fans



Gýrol Fluid Drives for Boiler Feed Pumps



Type ST Fly Ash Precipitators



Type VS Gýrol Fluid Drives for Mechanical Draft Fans

The Sirocco Induced Draft Fan (shown above) with die-formed forward curved wheel blades is designed and proportioned specially for induced draft work. **Now used on 1,000,000# /hr. steam boilers.**

The high static efficiency, low RPM, low tip speed, low inlet velocity, plus other important operating characteristics, make this fan particularly well adapted to severe power plant requirements.

For complete, concise, factual data on the Sirocco Induced Draft Fan, write for Bulletin 4424.

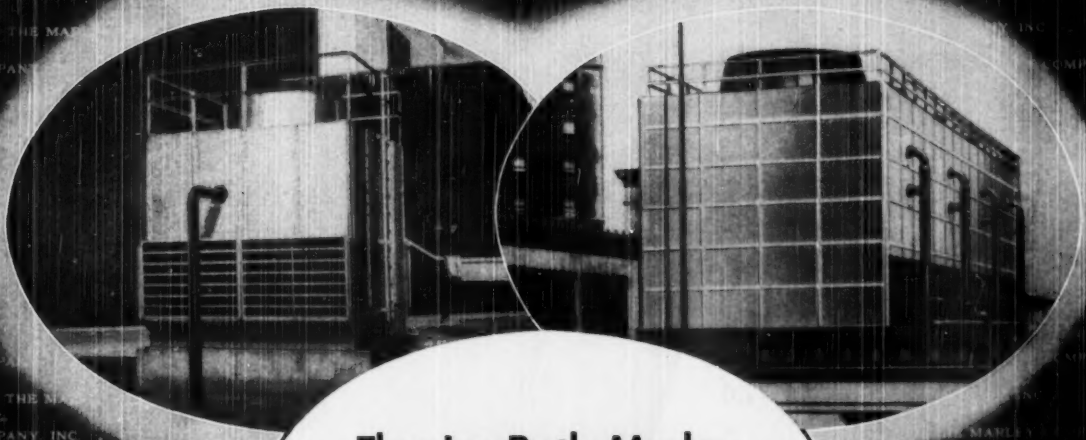
For data on other American Blower Mechanical Draft Equipment, Fly Ash Precipitators, Heavy Duty Coils and Gýrol Fluid Drives for fan control and boiler feed pumps—consult your nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

YOUR BEST BUY AMERICAN BLOWER POWER PLANT EQUIPMENT

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON



They're Both Marley Towers

Which Do You Need?

YOU want a cooling tower that will handle your water cooling job effectively at the least possible cost!

But, do you know which cooling tower will do it?

That's where Marley "know-how" fits into your picture. You have a water cooling job to do. There's a Marley designed and Marley built cooling tower to meet every water cooling need. Marley trained Application Engineers, working with you from the blue-print stage on, will help you get more for your money and assure complete, lasting satisfaction.

Shown above are two of the many Marley cooling towers from which Marley engineers can make a selection to fit your need:

The VAIRFLO (left) a medium capacity cooling tower with extra quality features at no extra cost. Vairflo extras include a balanced spray system with patented Marley low pressure nozzles . . . totally enclosed motor . . . grease packed ball bearings in enclosed bearing housing . . . lifetime nail-less filling . . . filling that is easily removed and installed . . . complete basin fixtures . . . Marley-designed cooling tower fan . . . multiple cells if desired . . . extra heavy framing and casing to give unusually long service. The Vairflo sets a new standard for air conditioning and refrigeration service. Available in wood or steel. Bulletin V-50.

The CONVENTIONAL (right) with a model to meet all heavy duty water cooling requirements. Only Marley Conventional towers offer all these features . . . rigid fan cylinders . . . cast aluminum or stainless steel fans . . . motors propery located outside the fan cylinder . . . positive drive action . . . drift eliminators independent of the distribution system . . . spray nozzle distribution . . . nail-less filling . . . independent louver posts . . . exclusive Marley mechanical equipment. Available in wood or steel. Asbestos board casing if desired. Bulletin C-50.

For guaranteed performance at lowest possible cost, ask a Marley Application Engineer to study your cooling requirements with you, from the blue-print stage on, and to give you a fair and impartial recommendation for the type of equipment that best meets your need. There's no cost nor obligation.

MAIL THIS COUPON TODAY

The Marley Company, Inc., Kansas City 15, Kansas

☐ Please send me, FREE, your latest illustrated folders entitled "What's Your Cooling Tower I.Q.?" I'm particularly interested in Cooling Tower Maintenance, Operation, Specifications, Testing, Water Treatment, Water Distribution.

☐ Have a Marley Application Engineer call to discuss our water cooling problem.

P-4

Name _____ Title _____

Company Name _____

Address _____

City _____ Zone _____ State _____

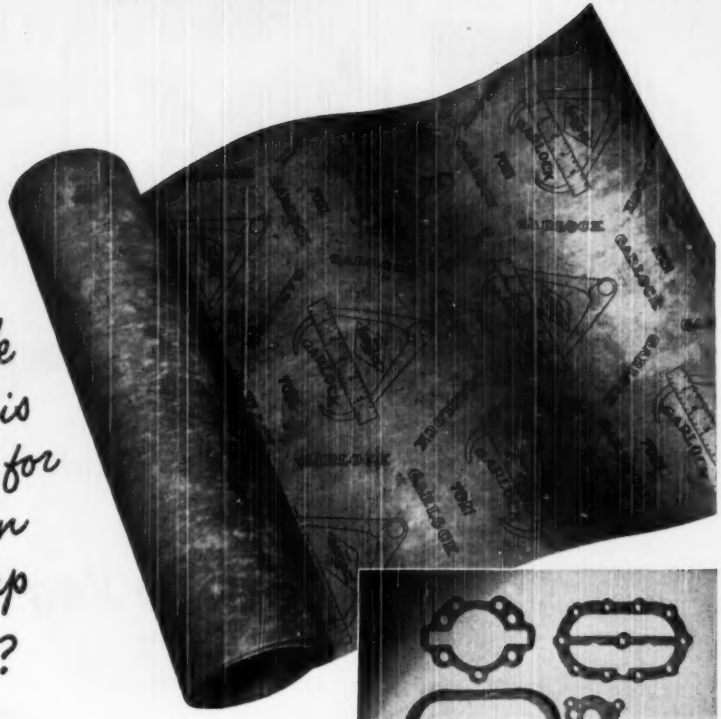
MARLEY

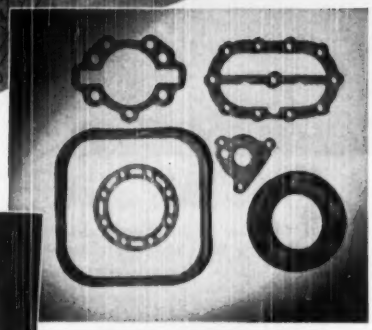
Double-Flow Vairflo DriCooler Natural Draft Counter-Flow Aquatower

Spray Nozzles

QUESTION:

Which Garlock gasket sheet is recommended for hot oils, steam or hot gases up to 700° F?





ANSWER:

Garlock 7021

Above: GARLOCK 7021 Compressed Asbestos Sheet. Thicknesses $\frac{1}{64}$" to $\frac{1}{4}$". Sheets 40" x 40" and larger. *Below:* GARLOCK 7022, Gaskets cut from 7021 sheet; all sizes and shapes.

GARLOCK 7021 Compressed Asbestos Sheet Packing is an ideal gasketing material for use against high temperatures and extreme pressures. It is sufficiently compressible to compensate for normal irregularities in flange faces but resistant to plastic flow under heavy bolt loads. Specially recommended for severe oil and steam service. A Garlock representative will call upon request.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK PACKINGS, GASKETS AND OIL SEALS

Above, *left*—The Kansas Power and Light Company Abilene plant installation of two 176 hp, 1170 rpm Magnetic Drives to induced draft fans. The drives are powered by 200 hp, 2200 volt, E-M Drip-Proof Squirrel-Cage Induction Motors. Installation also includes two 76 hp, 176 rpm E-M Magnetic Drives driving forced draft fans and operated by 100 hp, 220 volt E-M Induction Motors of the same type. **Above, *right*—** The four Regutron Controls in the installation.

Stop the biggest loss in boiler plants

WITH ADJUSTABLE-SPEED MAGNETIC DRIVES

The greatest loss in a boiler plant is the result of inefficient combustion. The cause is—too much or too little air; the cure is—better control of boiler draft fans for better combustion.

And so, when The Kansas Power and Light Company selected drives for its boiler draft fans, it chose to reduce combustion loss with the most precise system available—the E-M Adjustable-Speed Magnetic Drive with Regutron Control.

This wide range control of boiler fan speed *not only* increases boiler efficiency and stops fuel waste; *but also* extends the life of the fan by reducing wear and gives additional economics by reducing motor-power consumption through its precision control.

The E-M Magnetic Drive is a torque transmitting device that converts constant-speed drive from the motor into adjustable-speed drive for the fan. The Regutron Control operates to maintain fan speed to within 0.5% of the speed called for by your combustion controls. For the full story of its advantages, call in your nearest E-M sales engineer or write for our Publication 1078.

ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13, Minnesota

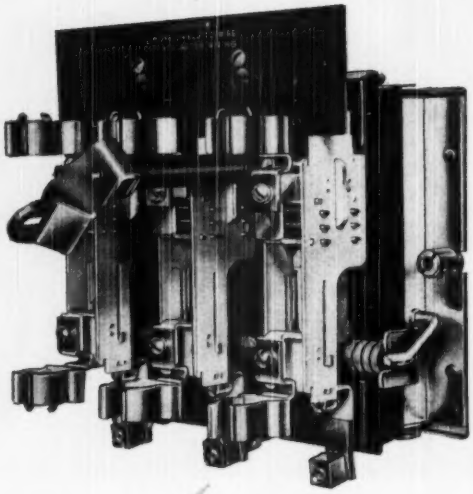
4400-TPA-2087

E-M ADJUSTABLE-SPEED MAGNETIC DRIVES

NOW...an ALL-NEW Type A Safety Switch for modern high-capacity distribution systems...

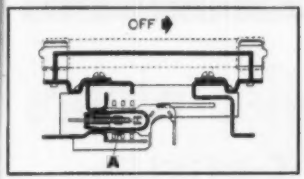
TRUMBULL'S HCI

HIGH CAPACITY INTERRUPTER

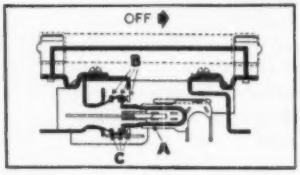


Unusually high interrupting capacity..."circuit-breaker" action breaks heavy loads quickly, safely. Extremely high momentary current capacity . . . withstands heavy short circuits without damage. 30-, 60-, 100-ampere sizes.

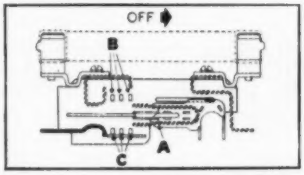
Here's How...
HCI's "Circuit-Breaker" Action Works



1. Switch closed. Spring-loaded sliding contact (A) fully inserted between stationary contacts. Heavy line is current.



2. Sliding contact being withdrawn. The two arcs repel each other, are drawn against grid pins (B) and (C), which break and cool them.



3. Contact fully withdrawn. Trumbull's unique "Circuit-Breaker" action has effectively extinguished the arcs.

CHECK THESE ADDITIONAL SPACE-SAVING, TROUBLE-PREVENTING, LIFE-LENGTHENING FEATURES

Center-front operation permits close ganging.

Front fusing allows compact box, yet gives ample wiring space.

No exposed live parts when switch is OFF and door is open.

Handle interlock.

Clear ON and OFF markings both inside and outside.

No dead center—roller-cam action (multiplying linkage design with powerful spring) throws switch to full OFF and ON.

Poles are self-contained switching units for easy replacement.

Silver-plated current-carrying parts prevent oxidation . . . give low-resistance contact.

Insulating parts made of linen melamene, light, strong, arc-resisting.

Enclosed operating mechanism (on 60- and 100-amp. sizes) prevents wire chafing.

Interior removable for wiring ease.

Underwriters' approval throughout.

For more information about Trumbull's all-new HCI Safety Switch, write for your free copy of Bulletin TEC-10 today. THE TRUMBULL ELECTRIC MANUFACTURING COMPANY, Plainville, Connecticut.

Men Who Observe the Best Electrical Practice Make It a Practice to Use

TRUMBULL (T) ELECTRIC

TRUMBULL'S TRAINLOAD OF NEW PRODUCTS

Not AN "IMPOSSIBILITY" FOR YOUR PLANT—

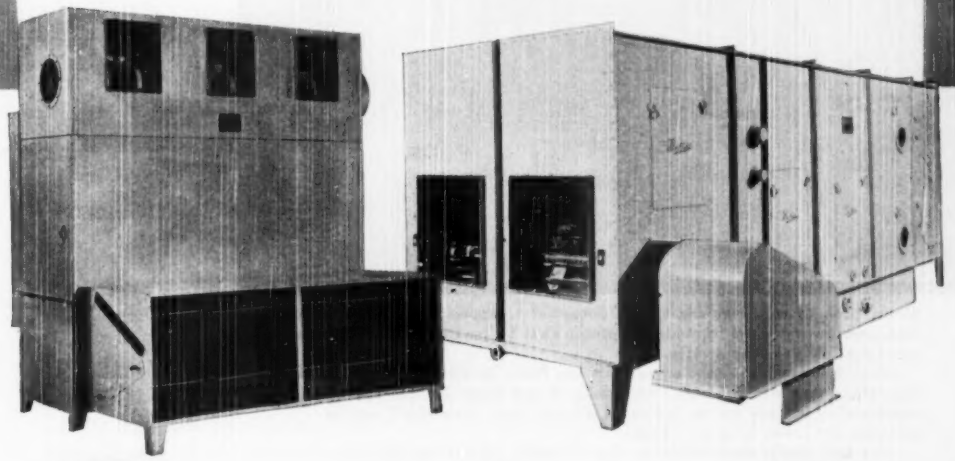
BUT AN IMPORTANT PRODUCTION AID!

LOW-COST, SIMPLIFIED *AIR CONDITIONING* BY "BUFFALO"

More and more modern plants ARE using "Buffalo" air conditioning, not on starry-eyed speculation, but for good, hard-headed business reasons!

First, these "Buffalo" Units are CONTROLLING plant climate—providing clean, properly humidified air at the right temperature constantly. Outside, let it snow, blow, rain or become hot or "muggy"—it's always comfortable inside. Workers do a better job faster, absenteeism from sickness declines. And produce quality is held to a uniform, high standard with the help of this clean, tempered air that's always exactly controlled.

Secondly, "Buffalo" units are developed to the point where installation and servicing are SIMPLE and relatively inexpensive. The VPC Cabinet, lower left, for example, comes in three basic interchangeable sections—can be moved in through standard plant doorways—takes very little space—and still provides COMPLETE Comfort conditioning in several sizes, up to 22,000 cfm. The "Buffalo" PCGW Cabinet, lower right, thoroughly WASHES and filters your air and provides temperature control in a remarkably compact, easily serviced unit. INVESTIGATE the benefits of "Buffalo" Air Conditioning in your plant—it will pay for itself quickly and in higher production!



A WEALTH of Air Information—Only $6

FAN ENGINEERING, 5th Edition, is industry's "Bible" on air and air problems. 806 pages, pocket size. Thoroughly indexed for quick reference. No engineer should be without it! Send check or M. O.

$6.00 Postpaid in U.S.A.

FIND OUT ABOUT the dependable "weather" these "Buffalo" Units can maintain in YOUR working areas—facts are yours for the writing in this Bulletin 3703. WRITE NOW!

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

488 BROADWAY BUFFALO, N. Y.

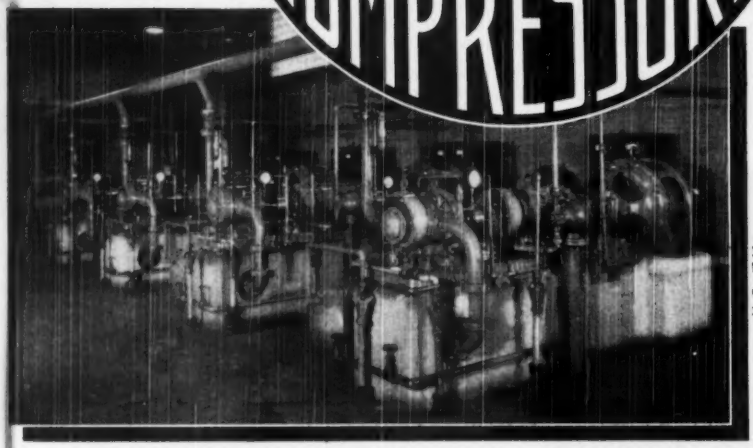
Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Branch offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

CAPACITIES TO 3300 C. F. M. ACTUAL FREE-AIR DELIVERY

FULLER ROTARY COMPRESSORS

PRESSURES TO 100-125 LB. GAGE



Installation of four Fuller Rotary Two-stage Compressors.

Capacity each, 490 c.f.m., 125-lb. gage pressure.

From time to time, we meet with potential compressor customers, who, for some unknown reason, have formed the opinion that Fuller Rotary Compressors are only good for low-pressure service.

This, however, does not agree with the facts, as we are in a position to furnish, and have furnished, hundreds of machines for 100 to 125-lb. pressure, which are giving the same efficient and dependable service as units for lower pressure ranges.

The first compressors built by this company (and which are still going strong), were of the two-stage type for 100-lb. service. It was some time before we began the manufacture of single-stage machines for the lower pressures required in various industries.

Bulletin C-5, illustrates and describes Fuller Rotary Compressors and Vacuum Pumps. We'll be glad to send you a copy. We invite your inquiries and investigation the next time you are in the market for compressors or vacuum pumps.

FULLER COMPANY
CATASAUQUA—PENNSYLVANIA
Chicago 3 - 120 So. LaSalle St.
San Francisco 4 - 420 Chancery Bldg.

No. 1 of a series

C-191

A LIFETIME OF NEW MACHINE EFFICIENCY

FULLER

IT'S CHEMICAL ACTION!

NO IT'S GALVANIC ACTION!

WHAT CAUSES CORROSION?

CHEMICAL ACTION?... low pH, dissolved oxygen, magnesium chloride, dissociation, caustic embrittlement?

GALVANIC ACTION?... electrolysis, non-uniformity of the surface, copper deposits?

Is it Chemical Action? Galvanic Action? Or both? There are many borderline cases and while *types* of corrosion can be determined—etching, pitting, gouging, grooving, cavitation, erosion, embrittlement—actual *causes* are frequently obscure.

The Drew System of Water Treatment eliminates guesswork! It starts with proper diagnosis. It includes recommendations for corrective treatment and other preventive measures such as modification of operating cycles and redesign of equipment, if required. It is specialized service applied to your individual boiler problem.

Corrosion can be prevented! If it exists in your boilers, steam lines, feed pumps, heaters, economizers, consult the Drew Engineer or write for further information.

POWER DREW CHEMICALS

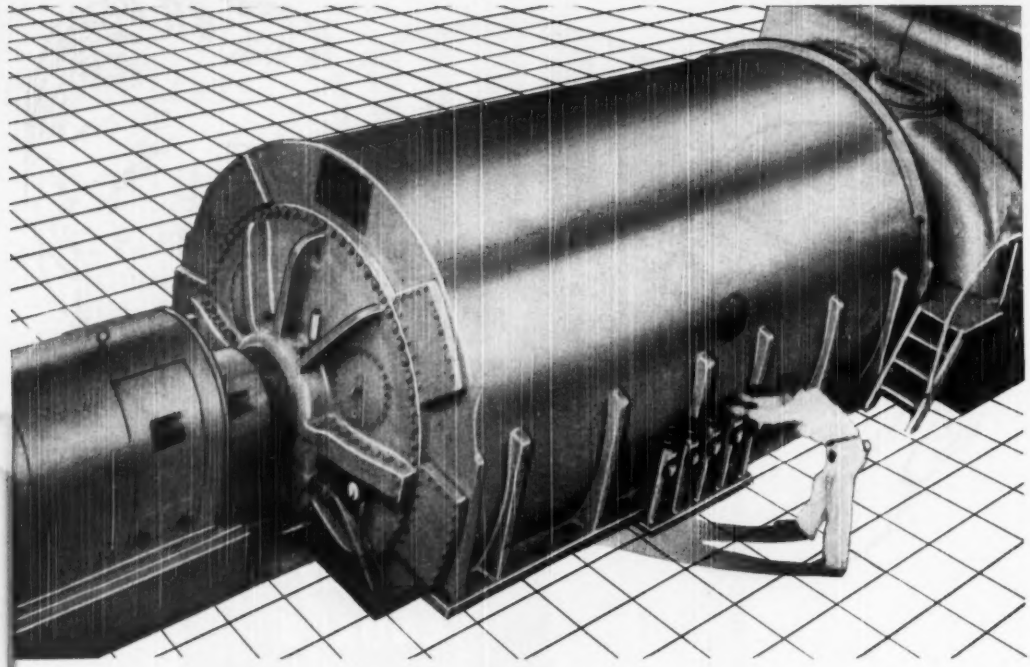
Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

NATIONWIDE SERVICE IN BOILER WATER AND COOLING WATER CONDITIONING

DREW PRODUCTS



OHIO PUBLIC SERVICE *specifies* HONAN-CRANE

for Turbine Oil Purification in 5 plants

The Ohio Public Service Company has used Honan-Crane oil purification equipment continuously for seven years, now has Honan-Crane installed in five of its big Ohio generating stations which produce a total of 470,000 kilowatts.

Ohio Public Service first installed a Honan-Crane purifier in the Mahoningside station at Warren, Ohio, in December, 1941, and since that time has purchased additional purifiers for generating stations located at:

R. E. Burger Station	**Dilles Bottom, Ohio**	**230,000 kw**
Edgewater Station	**Lorain, Ohio**	**100,000 kw**
Mahoningside Sta.	**Warren, Ohio**	**82,000 kw**
Scioto Station	**Marion, Ohio**	**38,000 kw**
Melco Station	**Mansfield, Ohio**	**20,000 kw**

Using Cranite (specially processed fullers earth), stations are able to operate continuously with turbine oil held to safe, low neutralization and steam emulsion numbers. At the R. E. Burger station a variable schedule of purification has been established. Cellulose fibre is used as the regular filtering medium and is replaced by Cranite where the S. E. or neut numbers rise above specified limits. This more economical plan of purification is easy to accomplish because of the flexibility of Honan-Crane purifiers in accommodating either type of filtering media.

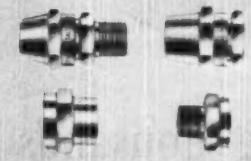
Honan-Crane oil purification equipment maintains Turbine oil in its original clean condition, removing oil contaminants as rapidly as they appear. Maximum turbine operating efficiency is possible and safe use life of oil extended because Honan-Crane purifiers give control over type of contamination that causes neutralization and S. E. numbers to rise beyond desired limits. For complete information on turbine oil purification, and Honan-Crane oil purifiers, write to 200 Superior Avenue, Lebanon, Indiana.

HONAN-CRANE CORPORATION
a subsidiary of
HOUDAILLE-HERSHEY CORPORATION

One dependable source for every flexible metal hose requirement

Corrugated Metal Hose in steel, bronze and stainless steel.

Convoluted Metal Hose in variety of types — steel, bronze and alloys.



Couplings to meet every need.

CMH	HOSE USE
√	Steam Hose
√	Lubrication Hose
√	Oil Lines
√	Coolant Hose
√	Pneumatic Hose
√	Hydraulic Hose
√	Chemical Hose
√	Insulated Hose
√	Charging Hose
√	Expansion Joints
√	Flexible Connections
√	Exhaust Hose
√	Platen Press Connections
√	Tar and Asphalt Hose
√	Metal Conduits
√	Loading & Unloading Hose
√	Gas & Air Hose
√	Vacuum Hose
√	General Utility Hose
√	Bellows
√	Flexible Lamp Arms

Expansion Joints for high and low pressures — stainless steel and copper.

Bellows in all sizes for all requirements — stainless steel and brass.

Metal Conduits in a variety of types and materials.

Now you can secure all your flexible metal hose needs from a single manufacturer. The handy check list above indicates only the more common types and assemblies manufactured by CMH. Other types and assemblies are also available. Bulletin 102, illustrated at the left, an application guide for CMH Flexible Metal Hose is available on request. Other literature giving full details on expansion joints, bellows and speciality items is also available. Write for your copies of the material in which you are interested and have it available for reference at all times.

Flexon identifies CMH products which have served industry for more than 47 years.

CHICAGO METAL HOSE CORPORATION

Maywood, Illinois

Plants at Maywood, Elgin and Rock Falls, Illinois

In Canada: Canadian Metal Hose Company, Ltd., Brampton, Ontario

This Exide Battery is cranking thousands of your engines, Mr. Diesel

When your engines first came into general use, Mr. Diesel, its high compression ratio made cranking a major problem. Exide engineers solved it by building a battery designed specifically for the job.

To engine builders . . . and manufacturers of Diesel-powered equipment . . . and users of Diesel engines . . . this means: When an Exide does the cranking, your engines START.

You can count on a *quick breakaway, high cranking speeds, low voltage drop.*

You can count on trouble-free performance . . . in rugged service . . . in all climates.

You can count on long battery life and low cost maintenance . . . proved daily in buses, trucks, trailer tractors, off-the-highway equipment, ships, power plants, Diesel-electric locomotives.

For dependable service at a saving, use Exide Diesel-cranking Batteries.

THE ELECTRIC STORAGE BATTERY COMPANY
Philadelphia 32
Exide Batteries of Canada, Limited, Toronto

WHATEVER YOUR CRANKING PROBLEMS
Exide's Research Staff—the largest in the industry—is ready to put its vast experience to work for you.

"Exide" *Reg. Trade-mark U. S. Pat. Off.*

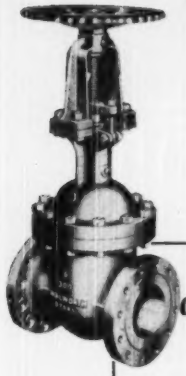
1888 . . . DEPENDABLE BATTERIES FOR 62 YEARS . . . 1950

WALWORTH

Cast Steel Gate Valves

Series 150 and 300

Wedge Gate — Outside Screw and Yoke



Sectional view of Series 300

Big 8-Point Superiority!

Gland clearances are such that stem cannot be scored if gland should be tightened unevenly.

Deep Stuffing Boxes in all sizes (2" to 24") insure tightness and maximum packing life – costly leaks are eliminated.

Bonnets and Bodies are engineered to withstand pressure and minimize distortion – they're tough, durable, dependable.

Heavy Steel Walls provide extra strength and longer life.

Integral Body Guide Rib Faces are machined to insure accurate disc seating.

Seat Rings are bottom seated – not flange type. No recess exists at back of ring – hence no turbulence, erosion, or pressure drop.

Streamlined Ports allow high velocity, non-turbulent flow, and reduce the possibility of erosion.

Valves regularly have flanged ends. They can be supplied with ends for butt welding. Rolier bearing yokes are available. On valves 5 inches and larger, by-passes can be furnished.

For Series 600 and higher, we recommend Walworth Pressure-Seal Steel Gate Valves.

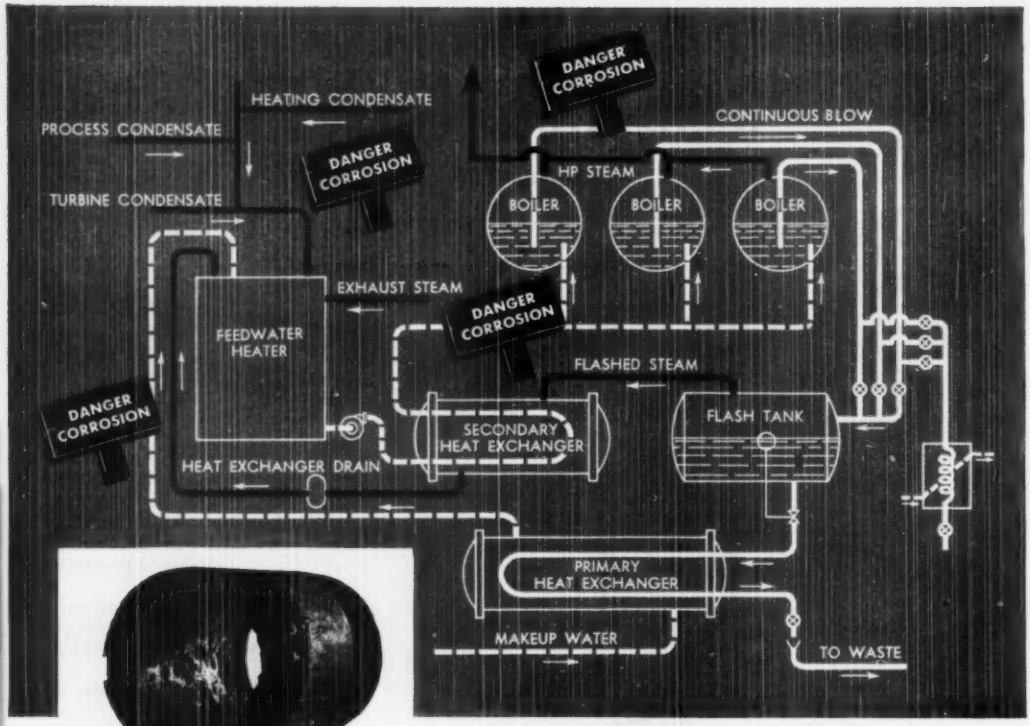
For further information on Walworth Cast Steel Gate Valves, see your local Walworth distributor, or write:

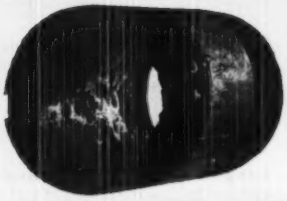
WALWORTH

valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD





AVOID These Danger Signs with BIRD-ARCHER Amine Treatment

CORRODED condensate return lines lead to expensive pipe replacement and maintenance. As an added annoyance, the solid products of corrosion often plug return lines and fill traps. You can steer clear of these troubles by using the *effective, economical* Bird-Archer Amine Treatment.

HERE'S THE WAY THIS B-A TREATMENT WORKS

Amines are fed into the boiler or into the steam and condensate systems. The amines raise the pH value of the condensate and also tend to inhibit equipment-destroying corrosion through surface protection of the metal itself.

HERE'S HOW THIS B-A TREATMENT SAVES MONEY

Raising the pH value of the condensate severely decreases maintenance costs by eliminating corrosion. These savings may more than offset the amount of treatment required to provide protection for your equipment.

NEW BULLETIN gives full details on the Bird-Archer Amine Treatment. . . . contains case histories that prove its successful application in many plants. *Write for your copy today.*

BA-184

WHAT AMINES ARE

Amines are members of a class of chemical compounds in which one or more hydrogen atoms of the ammonia molecule are substituted by an organic group. Some of the simpler types are soluble and volatilize from boiler waters. The alkalinity of the amines is an inherent property and does not result from decomposition. *No free ammonia is released.* In the concentrations necessary for protection of condensate systems, amines are harmless to non-ferrous metals, non-toxic and are completely stable at temperatures approximating 675F.

BIRD·ARCHER
WATER TREATMENT

THE BIRD-ARCHER COMPANY, 400 MADISON AVE., NEW YORK 17, N. Y.

Philadelphia, Pennsylvania • Chicago, Illinois • Montreal, Canada

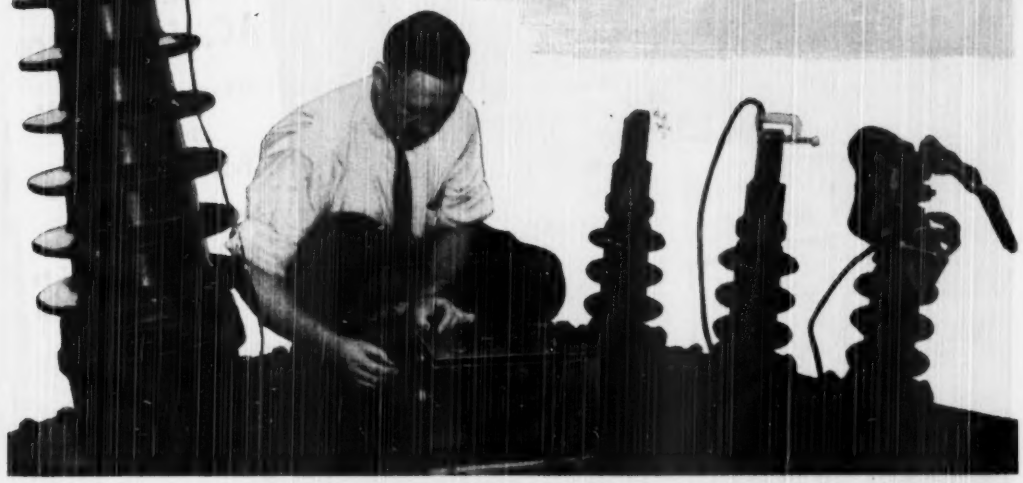
CALDERAS Y ACCESORIOS, S. A. AMSTERDAM 291, MEXICO, D. F.

Diagnose Transformer Trouble

in the field

reduce delay and expense

spot trouble while in service position



THE BIDDLE TRANSFORMER TURN RATIO TEST SET is a *New Tool* in transformer work

It is designed for use on power and distribution transformers, including auto-transformers.

It provides *for the first time* a portable device for measuring turn ratio with high precision.

It can be carried anywhere, to the top of large transformers, in the transformer shop or stock location.

With it you can:

- Measure the turn ratio of new, repaired and rewound units, both power and distribution types.
- Check polarity.
- Quickly identify leads and taps.
- Check tap-changer settings.
- Investigate load division and circulating current between units or banks.
- Detect shorted or missing turns.
- Locate concealed faults.

The "TTR" Set is essentially a reference transformer with characteristics—in respect to measurements of turn ratio—that match those of the power and distribution transformers you desire to test. Its ratio is adjustable from 0 to 130 and measurements are easily obtained by direct reading from the indexes of four dial switches using the null-balance comparison system. It features a hand-cranked, 8-volt a-c generator which renders it independent of any outside source of current. Hence, it is a safe and practically shock-proof, one-man instrument.

Owners of the "TTR" Set tell us that in the short time they've used it, it has paid for itself in analyzing conditions in transformers during manufacture, at installations, and in maintenance and trouble work. For the price, and more detailed descriptions of the "TTR" Set, we invite you to send for Bulletin 55-P.

JAMES G. BIDDLE CO.

Electrical & Scientific Instruments

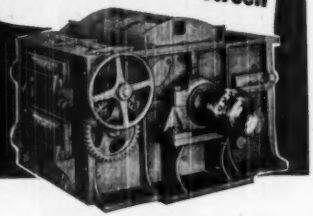
1316 ARCH STREET, PHILADELPHIA 7, PA.

Megger® INSULATION TESTERS • GROUND TESTERS • OHMMETERS

FOUR MILLION TONS OF COAL CRUSHED

with a parts replacement cost of only $.0005 per ton

AMERICAN AC3-E CRUSHER
in continuous service for 10 years
reduces 300 TPH 6" x 1¼" washed coal to 100% passing 1¼" screen



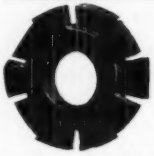
AT THE LITTLE SISTER COAL CORPORATION (St. David, Ill.)

. . . this crusher is giving a performance that is typically American—*typical* because American Crushers are engineered to "take it," and are *tested in actual use.* They slash power and labor costs too, and cut out-of-service time to a minimum. *Here are a few construction "whys" behind American records—*

THE HEAT TREATED ALLOY STEEL MAIN ROTOR SHAFT—revolves on heavy duty Timken Bearings enclosed in dust and oil-tight pillow blocks. *Perfect balance eliminates vibration.*

THE HEAVY RIBBED SECTIONAL FRAME—Cast Steel—permits *accessibility and adjustability* . . . bearing pedestals are cast integral with side frames to assure rigidity.

THE ALL-MANGANESE STEEL CRUSHING PARTS include renewable Breaker and Grinding Plate, also Crushing Chamber cheek liners. Grinding Plate is adjustable to compensate for long wear.



REVERSIBLE SHREDDER RINGS
In reducing coal by *controlled cleavage* (instead of by crushing), these 20-edge manganese steel rings give uniform, high tonnage reduction, with a minimum of degradation, operating at slow (275 to 350 RPM) power-saving speeds.

Let an American representative analyze your crushing problem. Also, we'll be happy to send you our bulletin "Crushing Coal at Less than One Cent Per Ton."

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1349 MACKLIND AVE.
ST. LOUIS 10, MO.

HARBISON-WALKER

Castable REFRACTORIES

For monolithic refractory furnace linings, patches, baffles, door linings, and special shapes for a wide diversification of high temperature use Harbison-Walker CASTABLES.

UP TO 2750° F. H-W SUPER CASTABLE provides an added margin of refractoriness and greater volume stability. Excellent for use where super-duty quality is needed.

UP TO 2400° F. use H-W STANDARD CASTABLE. Shipped dry in 100 lb. sacks. Negligible shrinkage and expansion.

INSULATING SERVICE UP TO 2200° F. is provided by H-W LIGHTWEIGHT CASTABLE. Combines high strength and refractoriness with insulation.

H-W 56 LIGHTWEIGHT CASTABLE is a high grade insulating refractory, combining the properties of light weight and strength to the utmost degree. Only 56 lbs. per cubic foot of construction are required. It has exceptionally good strength and volume stability throughout the entire temperature range. It can be cast in place, troweled, or gunited with equally good results.

The thermal conductivity of H-W 56 LIGHTWEIGHT CASTABLE is 60% less than that of high duty fireclay brick.

Many opportunities for time savings and cost reductions are afforded by the use of H-W CASTABLES. An experienced technical staff welcomes your call for consultation.

Trade Mark Reg.

Harbison-Walker Refractories Company

AND SUBSIDIARIES

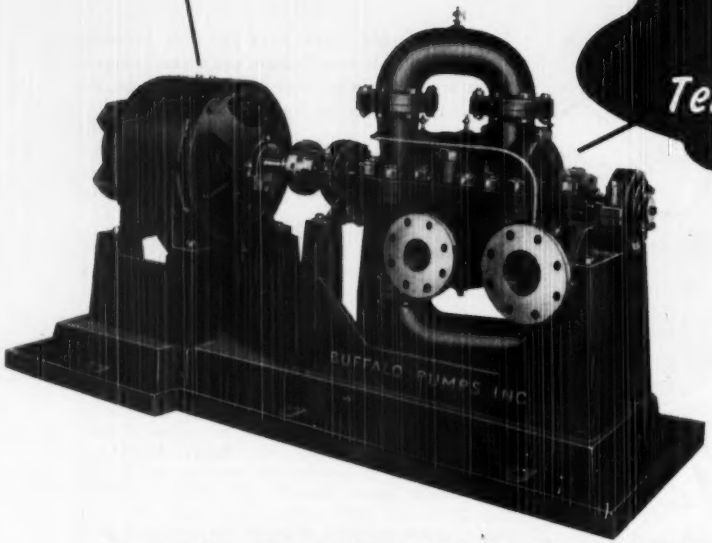
General Offices Pittsburgh 22, Pa.

World's Largest Producer of Refractories

For Pressures up to 1500 Ft.

For Clear Water Service

Efficient at any Temperature



"Buffalo"
"RR"
PUMPS

READY TO CUT YOUR PUMPING COSTS

If you have a clear-water pumping application calling for a high head and capacity between 20 to 900 gpm., you'll get satisfaction with an "RR". These "Buffalo" Single Suction Two and Four Stage Pumps have set both efficiency and endurance records on the job — in air conditioning, boiler feed and other general service. Thousands in use all over the country. WRITE FOR BULLETIN 980-B for the facts on these pumps users say you can "put in and forget".

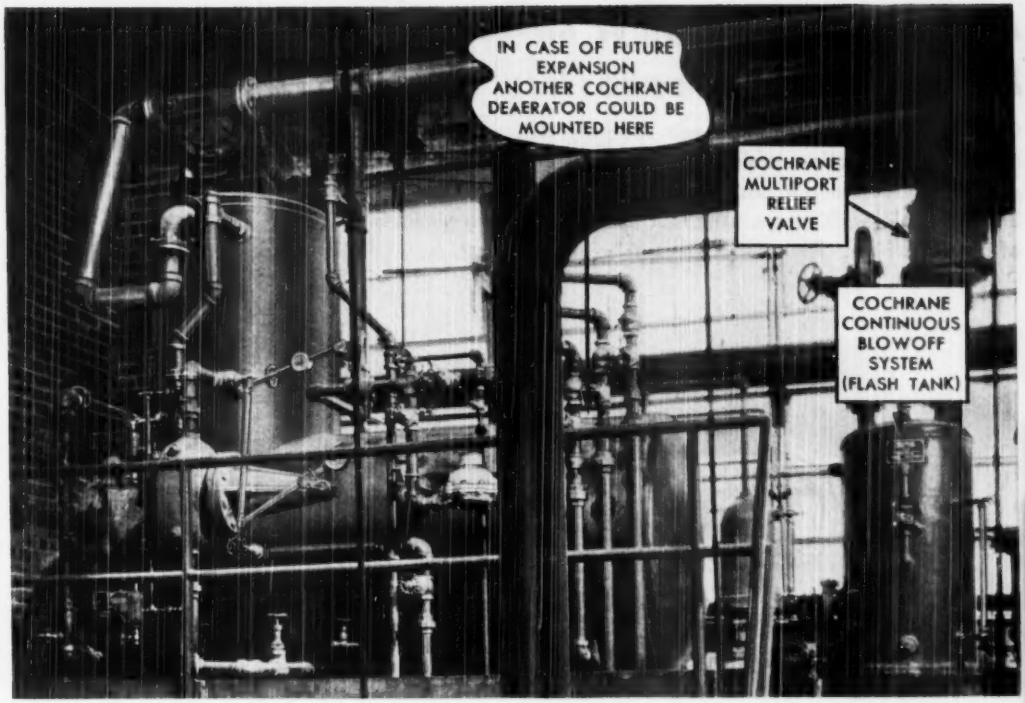
—for handling clear water at high pressures, any temperature
"Buffalo"
Class "RR" Single Suction Multistage Pumps
BUFFALO PUMPS, INC.

BUFFALO PUMPS, INC.

488 BROADWAY **BUFFALO, N. Y.**

Canada Pumps Ltd., Kitchener, Ont.

Branch Offices in all Principal Cities


IN CASE OF FUTURE EXPANSION ANOTHER COCHRANE DEAERATOR COULD BE MOUNTED HERE
COCHRANE MULTIPORT RELIEF VALVE
COCHRANE CONTINUOUS BLOWOFF SYSTEM (FLASH TANK)

COCHRANE DEAERATORS

ALSO FIT THE SMALL PLANT AND LEND THEMSELVES TO

FUTURE EXPANSION

Above is shown a neat installation of a Cochrane deaerator and other boiler plant equipment in a plant where space requirements are limited. The installation on a balcony not only provides adequate room for inspection and servicing but is laid out with an eye to future expansion.

The 30,000 lb/hr. Cochrane deaerator, in a rolled steel cylindrical shell, is mounted at one end of a 9' 3" x 4' 0" diameter rolled steel horizontal cylindrical storage tank. Another deaerator of similar capacity may be mounted on the other end in case of future expansion of the boiler plant.

This progressive plant not only thus insures protection against rust and corrosion of piping, economizers, etc., by the Cochrane Deaerator but is saving fuel and saving heat by the installation of a Cochrane Continuous Blowoff System instead of using the old, wasteful system of intermittent boiler blow down. The Cochrane Multiport Relief Valve shown is another Cochrane product that insures efficient operation by eliminating danger of sticking, jamming or freezing, by its unique design of many valve discs instead of one.

Cochrane equipment is designed for the economical, efficient and safe operation of boiler plants.

COCHRANE

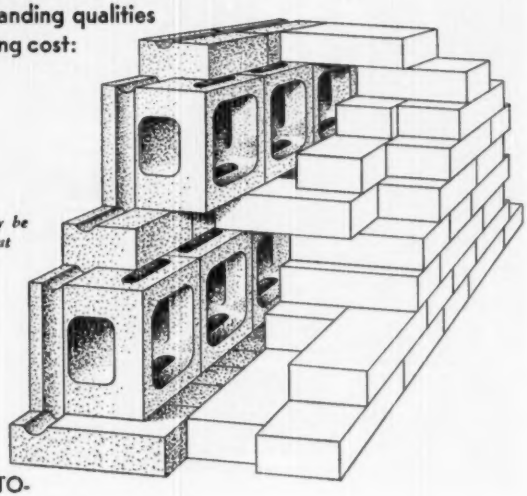
COCHRANE CORPORATION 87 YEARS OF SERVICE 1863 - 1950

DEAERATORS

Cochrane Corporation, 3106 N. 17th St., Phila. 32, Pa. In Canada: Canadian General Electric Company, Ltd., Toronto.

For Efficient Operation of Air-cooled Boiler Walls — NOTHING Beats the Serviceability of CRYSTOLON® BLOCKS

CRYSTOLON Hollow Blocks are specially designed for the scientific construction of air cooled walls in boiler furnaces. In addition to their unique design, these blocks (like CRYSTOLON Bricks for solid walls) possess the four basic outstanding qualities of silicon carbide. The result is lowered boiler lining cost:



Crystolon air-cooled blocks may be obtained in the shapes illustrated at the right (Type A) or in T or K shapes (designated as Types B and C).

(1) **Unusually high refractoriness.** Bonded CRYSTOLON Shapes are successfully used at temperatures up to 2900°F. (1595°C.).

(2) **Resistance to slag action.** The action of molten slag is tough on any refractory—but CRYSTOLON blocks and bricks are made so dense that slag will not take hold by penetration.

(3) **Resistance to clinker adhesion.** CRYSTOLON blocks and bricks are designed to reduce the adhesion of clinkers to a minimum. If clinkers do adhere to a limited extent, they are easily removed without any damage to the surface of the block or brick.

(4) **Resistance to abrasion.** Silicon carbide is an abrasive material of extreme hardness and, therefore, CRYSTOLON blocks and bricks show remarkable resistance to abrasion—including that caused by the moving fire bed of a stoker-fired furnace.

CRYSTOLON air cooled blocks are designed as a full block having a 9″ base or as a half block with a 4½″ base. They have a definite relation to the standard 9″ CRYSTOLON straight brick and can be used in conjunction with it. In addition there are modifications of the 9″ brick shapes, provided with standard tongues and grooves, for use in conjunction with the blocks as both headers and stretchers. The blocks are made with either a blank face or a perforated face having two or four holes.

NORTON
REFRACTORIES®
NORTON COMPANY
WORCESTER 6, MASSACHUSETTS

APARTMENT FOR SLIME

With condenser tubes handling unchlorinated water, slime-forming bacteria never have to worry about a housing shortage. Instead, these bacteria move in, form their colonies, and the condenser tubes become apartments for slime. When this happens, the terminal log mean temperature difference rises, excess steam costs go up, and outage increases along with the labor bill for costly plug cleaning.

Chlorination, engineered by W&T and backed by 35 years' experience, has proven itself the effective answer to slime in condenser and heat exchanging equipment. It is effective because the Wallace & Tiernan De-Sliming Process attacks the cause of slime, bacteria, and "evicts" these unwanted "tenants" from their home in your equipment.

CD-33

Regardless of whether yours is an open or closed cooling system or whether you use shell and tube, trombone, or open box condensers, Wallace & Tiernan engineering plus time-tested W&T Chlorinators can put all the money-saving advantages of slime control by chlorination to work on your condensers or heat exchange equipment.

Write today for complete information.

WALLACE & TIERNAN PRODUCTS, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

Belleville 9, New Jersey • Represented in Principal Cities

THERE'S NO PLACE FOR THESE TROUBLEMAKERS . .

IN PLANTS THAT CAN MAKE A STATEMENT LIKE THIS . .

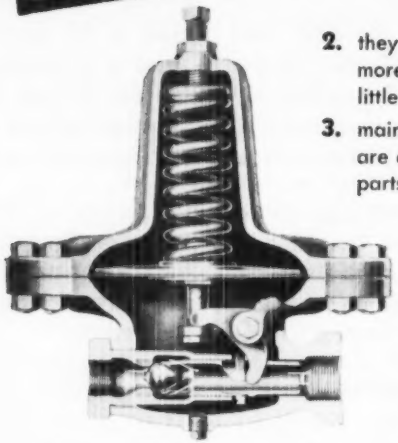
"We use your Streamlined '1000' Valves on the following equipment:

Heating Systems
Solution Heaters
Plating Tanks
Degreasing Machines
Hot Water Heaters

CASH STANDARD *Streamlined* TYPE 1000 PRESSURE **REDUCING VALVE**

"We use them:

1. because they hold close delivery pressure control.
2. they don't get gummed up, so we get more and better production with very little lost time.
3. maintenance cost is very low—the guts are cheap—old parts come out and new parts go in easily with little time lost."



ITS ASPIRATOR AND STREAMLINED FLOW WORK TO YOUR BENEFIT IN THESE 12 WAYS . . .

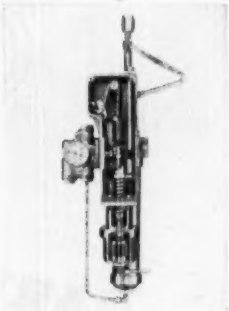
1. Maximum Capacity when needed most. 2. Accurate Pressure Control under toughest working conditions. 3. Trouble-free Service. 4. Smooth Operation. 5. Tight Closure. 6. Accurate Regulation. 7. Speedier Production Results. 8. Elimination of Failures. 9. Constant Delivery Pressure. 10. Cost Saving Operation. 11. No Spoilage. 12. Practically zero in maintenance costs.

CASH STANDARD CONTROLS . . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

Send for them



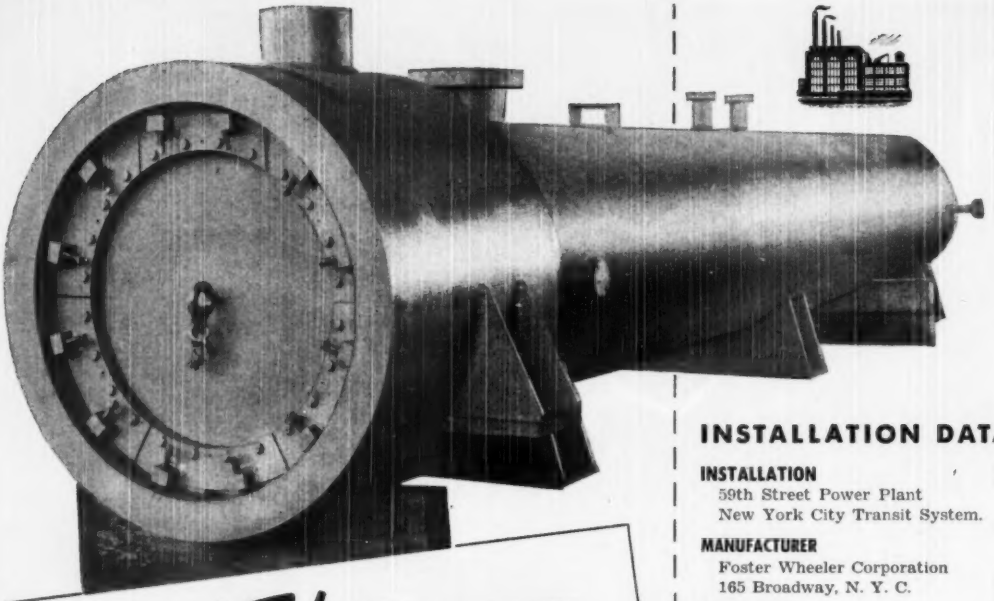
Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.

Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.

Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

TAMES A
POWER THROB
FLEXINEERING ELIMINATES VIBRATION ON TUG DIESEL EXHAUST
. . . PROVIDES SMOOTHER POWER . . . COOLER OPERATION
When the giant 16 cylinder, 1750 horsepower diesel engine of the new tugboat, Grace Moran, roars into action, there's a smooth purr of silky power. And one of the keys to this vibration-free operation is "flexineering"—the scientific engineering of flexible metallic tubing to industry's specific needs.
From the exhaust to the stack is a five foot length of Penflex air jacketed 14 inch, interlocked, flexible metallic tubing which achieves a circulation of air and an efficient cooling action.
Tough, rugged tubing that keeps exhausts as tight as a pipe . . . yet provides all of the flexibility necessary to "soak up" the constant vibration.
In the power field—whether it is an exhaust lines, air lines or the many other places where tubing is used—you will find Penflex engineers ready to help you solve your problems. Penflex tubing is available in bronze, galvanized steel and stainless steel . . . in sizes from ⅛ inch I. D. to 24 inch I. D. Write for your copy of "Flexineering."
PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.
7238 Powers Lane
Philadelphia 42, Penna.
Branch Sales Offices
BOSTON • NEW YORK • CLEVELAND
CHICAGO • HOUSTON • LOS ANGELES
Penflex . . . HEART OF INDUSTRY'S LIFE LINES

Copyright 1949—Penna. Flexible Metallic Tubing Co.



Monel Tubes have many advantages in Boiler Feed-water Heaters

Foster Wheeler Corporation designed and built the above boiler feed-water heater (and a mate) for the 59th Street Power Plant of the New York City Transit System, to specifications set by Burns and Roe, Inc.

And into each heater went 550 Monel® U-tubes . . . *insurance for long, efficient service.*

Here are some of the reasons why Monel was specified in place of more commonly-used metals:

1. Higher mechanical properties . . . which means better heat transfer because lighter gauges can be used.
2. Better all-'round corrosion resistance . . . which means longer life, fewer failures, less "downtime."
3. Greater hardness . . . which means better resistance to erosion and cavitation. And when tubes stay smooth, you get faster flow, better heat transfer.
4. High ductility . . . which means tight rolled joints in tube sheets, and ease of forming bends in U-tube heaters.
5. Easy weldability . . . which means conventional welding techniques can be used to weld the Monel tubes into the steel tube sheet, if welding is specified.

Consider Monel the next time you design, install or re-tube a heater. No other metal offers so many advantages for this use. For more information on Monel heater tubes, write to P. F. Sheridan at Inco.

INSTALLATION DATA

INSTALLATION
59th Street Power Plant
New York City Transit System.

MANUFACTURER
Foster Wheeler Corporation
165 Broadway, N. Y. C.

SPECIFICATIONS
Burns and Roe, Inc.
233 Broadway, New York 7, N. Y.

TUBE DETAILS
Each heater has 550 Monel U-tubes, ⅝" O.D., 17 B.W.G. (.058" wall).

LOCATION
Two of the illustrated, closed-type, Monel-tubed feed-water heaters will be installed between boiler feed pump and boiler. (Three direct contact heaters are in the line before the feed pump.)

OPERATING CONDITIONS
950° F., 1250 psi at turbine throttle.

FIRST-STAGE MONEL-TUBED HEATER
Uses 450 psi, 680° F. bleed steam in shell. Outlet water temperature: 421.4° F.

SECOND-STAGE MONEL-TUBED HEATER
Uses 900 psi, 860° F. bleed steam in shell. Outlet water temperature: 515.1° F.

WATER PRESSURE IN HEATER TUBES
2000 psi design.

WATER VELOCITY THROUGH HEATER TUBES
3.97 feet per second.

CAPACITY OF HEATERS
693,000 pounds of water per hour.

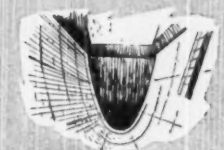
EMBLEM OF SERVICE
INCO
TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC. • 67 Wall Street, New York 5, N.Y.

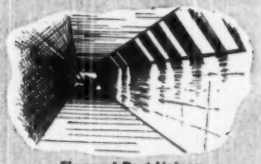
WHERE TO USE LUMNITE IN POWER PLANTS

Steel Stack Linings

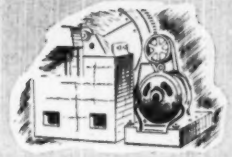
Ash Pit and Cinder Catcher Linings



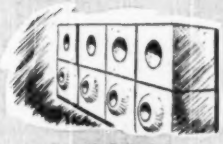
Coal Bunker Linings



Flue and Duct Linings



Overnight Structural Concrete

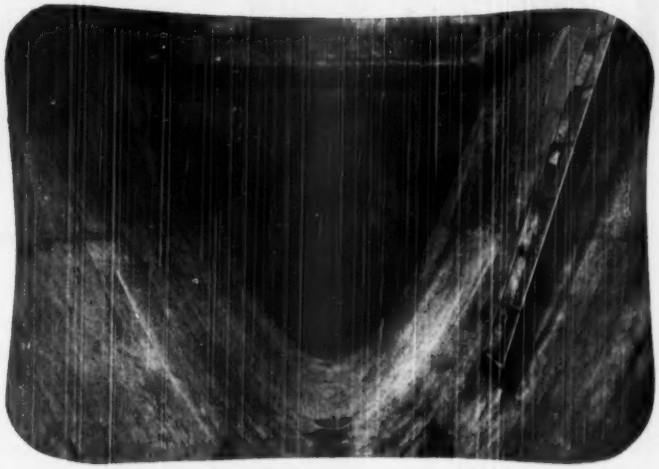


Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

COAL BUNKERS SAFE FROM CORROSION

with tough "LUMNITE" linings



YOU minimize corrosion and abrasion when you line your coal bunkers with concrete made with LUMNITE calcium-aluminate cement.

In lining bunkers, ""LUMNITE" cement protects against the corrosive action of sulphurous water leached from coal. Applied with a cement gun, dense LUMNITE-based concrete prevents corrosive water from working in between the lining and the steel.

Tougher, smoother surfaces result from the monolithic, one-piece construction of LUMNITE. Absence of joints means less wear on linings subject to abrasion from the coal. Maintenance costs are reduced. And, because LUMNITE-based concrete reaches service strength in 24 hours or less, outage time is kept to a minimum.

For coal bunkers, resistance to abrasion and corrosion is the outstanding feature. In other power plant applications . . . flues, chimneys, ash pits . . . LUMNITE linings provide high structural strength *plus* high heat resistance and low thermal conductivity. Send for further information.

""LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.

Specify castables made with LUMNITE

P-L-8

Lumnite Division

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL CORPORATION SUBSIDIARY

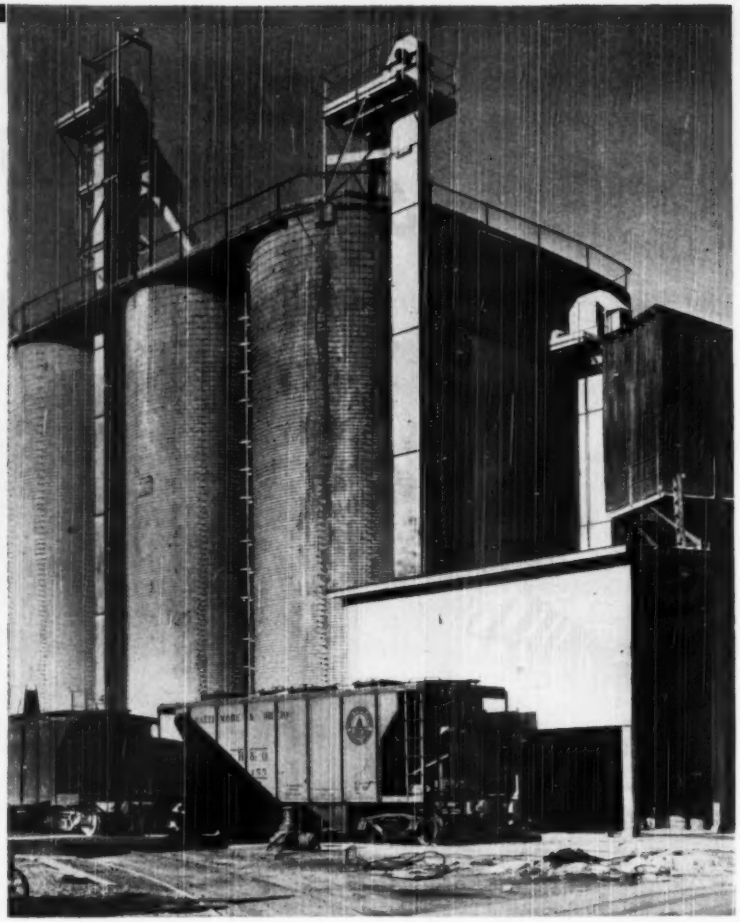
135 EAST 42nd STREET • NEW YORK 17, N. Y.

"THE THEATRE GUILD ON THE AIR" — *Sponsored by U. S. Steel Subsidiaries — Sunday Evenings — NBC Network*

JEFFREY BUCKET ELEVATORS

New Improved Design

- Welded Angle Casings —heavy gauge steel Dust tight—Water tight
- Improved Head and Boot Sections
- Increased Bearing Protection
- Removable Hood
- Large Clean-out Doors both sides
- Large Inspection Doors for access to chain and buckets
- Take-ups furnished for Head or Boot if desired—self-aligning, plain or anti-friction bearings



Jeffrey Car Puller is shown in foreground.

These are only some of the features incorporated in our Standard Bucket Elevator line. A type and size to meet any requirement. Complete drawings available. Jeffrey Bucket Elevators are backed by years of engineering experience and hundreds of installations. May we hear from you?

Chains • Conveyors of all kinds • Feeders • Car Pullers • Bin Valves • Dryers and Coolers • Packers • Skip Hoists Screens • Crushers and Pulverizers Belt Idlers • Transmission Machinery Replacement Parts

THE JEFFREY MANUFACTURING COMPANY Established 1877

932 North Fourth St., Columbus 16, Ohio

Baltimore 2, Birmingham 3, Boston 16, Buffalo 2, Chicago 1, Cincinnati 2, Cleveland 13, Denver 2, Detroit 13, Harlan, Houston 2, Huntington 19, Jacksonville 2, Milwaukee 2, New York 7, Philadelphia 3, Pittsburgh 22, St. Louis 1, Salt Lake City 1, Scranton 3

Jeffrey Mfg. Co., Ltd., Head Office & Works, Montreal

Complete Line of Material Handling, Processing and Mining Equipment

...Digging for facts

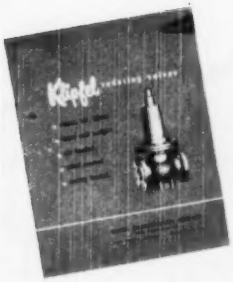
ON AUTOMATIC REGULATING VALVES?

YOU'LL FIND THESE KLIPFEL BULLETINS PRACTICAL, FACTUAL AND USEFUL!

Klipfel engineers have put a lot of experience and research into these bulletins to make them useful to you . . . the man who uses or specifies automatic regulating valves. Each bulletin covers such points as: the advantages and limitations of different valve constructions; selecting the proper type valve for given operating conditions; determining the most effective and economic size valve for the job.

In short, Klipfel engineers have prepared these bulletins to assist you in selecting the type and size valve best suited to your needs.

Write Dept. BC-4 for any bulletins you wish. We'll gladly send them to you.

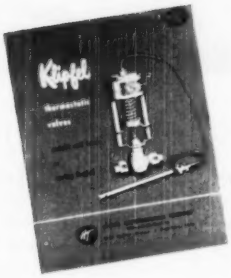


KLIPFEL REDUCING VALVES

for steam, air and water . . . in lever and weight, air loaded, pilot control and spring loaded types; descriptions, illustrations and complete selection data in Bulletin 148.

KLIPFEL FLOAT VALVES

Single and double seated types with direct action or pilot control for remote location. Types shown include quick-acting valves; all are available in angle and globe patterns. Bulletin 349.



KLIPFEL THERMOSTATIC VALVES

vapor pressure operated valves with spring or weight and lever loading. Valves are ball type, balanced cup and disc or balanced inner valves. Min. temp. 80°. Max. temp. 250°. Range limit of any instrument 40°.

KLIPFEL BACK PRESSURE AND RELIEF VALVES

for control of air, steam and water pressures at the valve inlet in various types for practically any service. Bulletin 648 gives complete details including dimensions and capacities.

Klipfel VALVES INCORPORATED

DIVISION OF HAMILTON - THOMAS CORPORATION, HAMILTON, OHIO

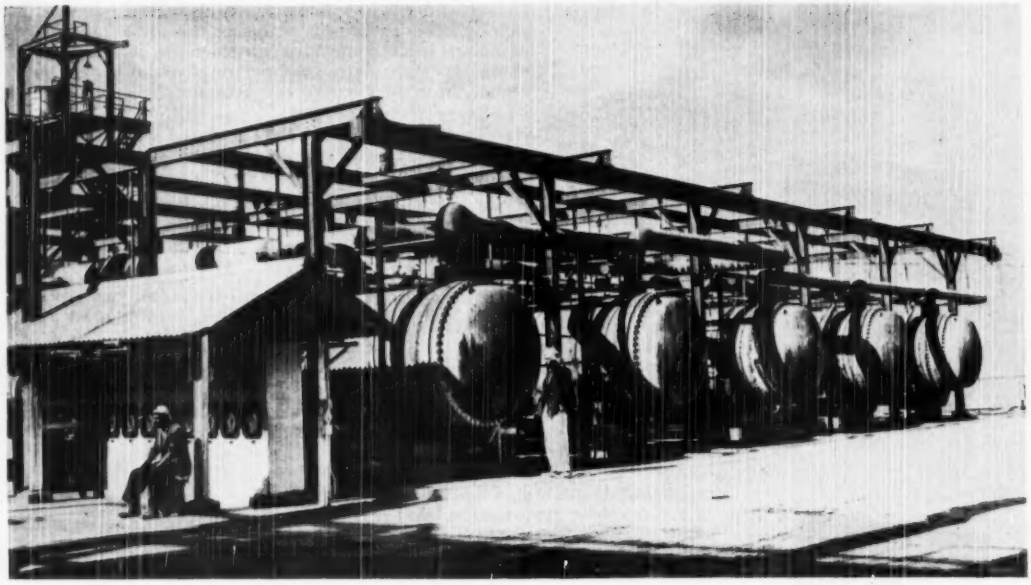
200,000 Pounds of Vapor per Hour

WERE NEEDED IN

Saudi Arabia

THE SELECTED EQUIPMENT...

G-R EVAPORATORS



When the Arabian American Oil Company, known as Aramco, built its Ras Tanura refinery, the company's engineers were particularly careful in their selection of equipment, because of the great distance from sources of supply and the difficulty of obtaining skilled operating labor.

With a long record of proven dependability and efficiency, Griscom-Russell Bentube Evaporators were the logical choice. The installation consists of five Type J-2 units, each designed to deliver 40,000 lb. of vapor per hour at 150 psig when supplied with steam at 220 psig and 400°F.

A recent continuous 42-hour test run shows an average output well above the specified and designed capacity, and also far less maximum impurities than specified.

Your own pure water requirements, too, can best be met by G-R Evaporators. Write for bulletin describing these units in detail, and explaining their association with the heat balance in various types of plants.

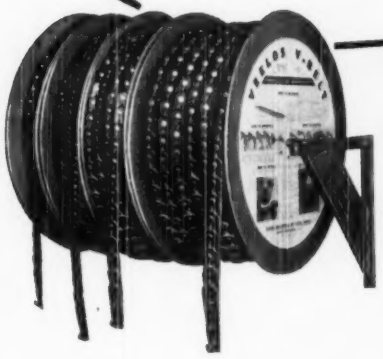
THE GRISCOM-RUSSELL CO., 285 MADISON AVE., NEW YORK 17, N. Y.

GR 218

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

HERE'S HOW TO REDUCE YOUR TOP-HEAVY V-BELT INVENTORY



..and keep your machines producing

WE'RE not the people to solve *all* your stockroom inventory problems—but, when it comes to stocks of v-belts, we can help.

There's no need to tie-up money and valuable stockroom space with hundreds of sizes of endless v-belts. Four reels of Veelos, the adjustable v-belt, can *replace* up to 316 sizes of endless v-belts—in the O, A, B and C widths. You may not use all these widths. If not, one or two reels of Veelos may be enough.

Veelos is easy to install without dismantling outboard bearings. Veelos runs true—delivers steady, full, vibrationless power. Veelos cuts down on machine maintenance because uniform tension can be maintained on all belts—relieving strain on bearings.

You *save* when you shift to Veelos.

WRITE FOR YOUR COPY

of the Veelos Data Book. It gives complete engineering, measuring and installation information on Veelos v-belts.

MANHEIM MANUFACTURING & BELTING COMPANY • MANHEIM, PA.

ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

Made in all standard widths, fits all standard grooves. Three types: regular, oil-proof, static conducting. Double V in A and B widths. Packaged on reels in 100-foot lengths. Sales engineers in principal cities; over 350 distributors throughout the country. Veelos is known as VEELINK outside the United States.

VEELOS
THE LINK
V-BELT

National Lock installs ILLCO-TEMP Softener

to reduce hardness in hot-process effluent without chemical additions

Power Plant,
NATIONAL LOCK CO.
Rockford, Illinois

For most efficient boiler operation in its new power-plant addition, National Lock solved the problem of after-precipitation and residual hardness in the effluent of its lime-soda softener.

As a result of a pilot-plant test, company engineers recommended the installation of a larger ILLCO-TEMP Softener (10,000 gph) to after-soften the lime-soda effluent without the use of additional chemicals.

The softener (shown at right) operates at 230° F. and has softened over 10 million gallons since its installation.

Exchange capacity of the softener has not declined. Also, through use of zero-soft water in boiler-feed make-up, National Lock has effected a reduction in the cost of chemical additions, as well as increased efficiencies resulting from clean boiler operation.

Write for other case histories and descriptive literature.

Advantages of ILLCO-TEMP

No chemical after-treatment is necessary to reduce hardness . . . with "zero" soft water obtained from the ILLCO-TEMP Hot-Process Unit. Chemical savings from this alone will normally pay for equipment in less than 2 years.

Assures a constant source of "zero" soft water regardless of variations in the raw water or the hot-process effluent.

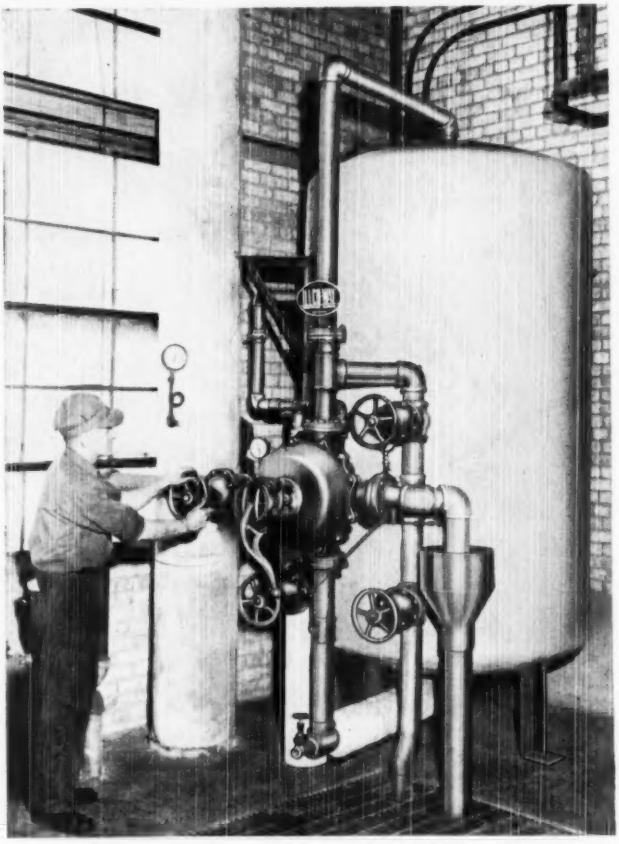
Decreases the excess dosages required for straight hot-process.

Reduces amount of chemicals required in boiler (none needed for hardness control).

Eliminates frequent adjustment.

Eliminates deposits which result in "plugging" in valves, feed pumps, feed lines, heaters, etc.

ILLCO-TEMP unit easily and economically added to your present lime-soda water softener.



ILLCO-TEMP SOFTENER installed in National Lock Company plant operates at 230°F., 10,000 gph.

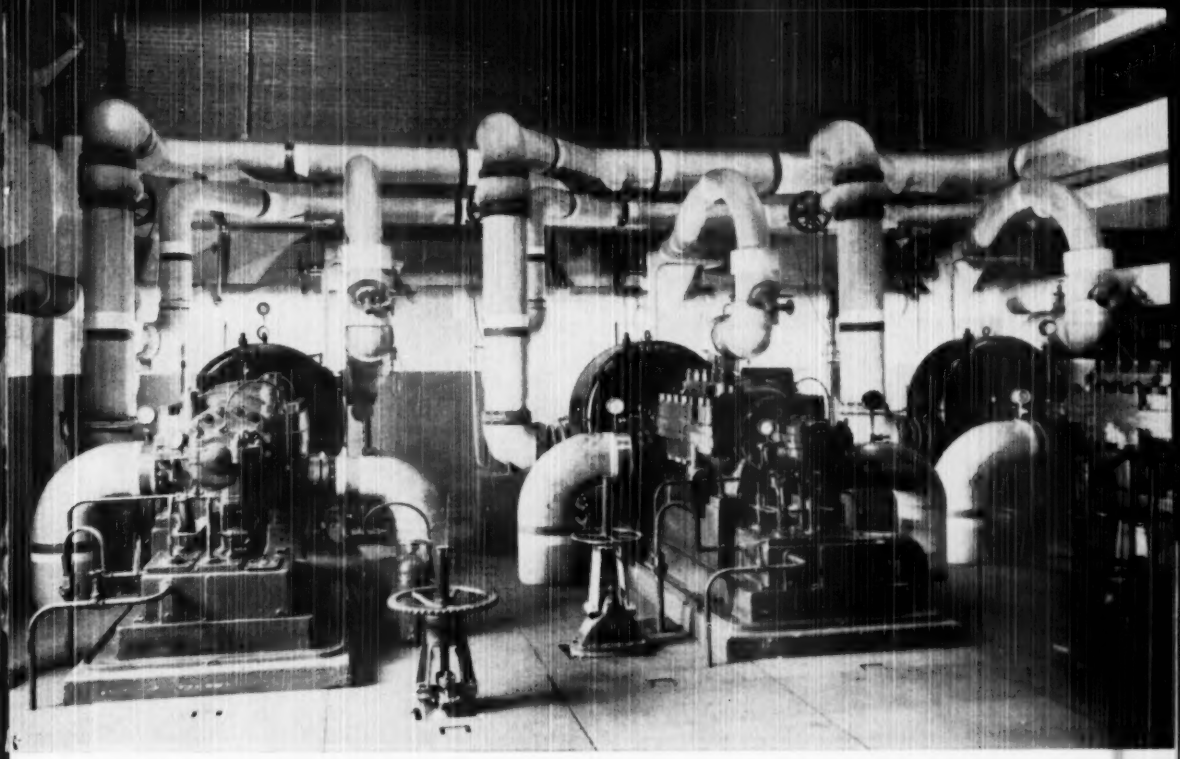
This is the only method today that withstands high or low pH at high temperatures. The ILLCO-TEMP Softener unit operates economically and continuously at temperatures as high as 250° F. . . . on waters having a pH as high as 10.5. This eliminates the need for a constant control and adjustment of the hot lime-soda dosage, as previously required.

ILLINOIS WATER TREATMENT CO., 853-4 Cedar St., Rockford, Ill.
New York Office: 7310-NN-4 Empire State Bldg., New York City

ILLCO-WAY

DE-IONIZING
DE-ALKALIZING
SOFTENING

ENGINEERING AND EQUIPMENT—DE-IONIZERS for process water treatment and treatment of liquids and solutions other than water; waste treatment; reclamation of specific constituents. DE-ALKALIZERS: Domestic. FILTERS, etc.



GETTING BIG POWER AROUND CORNERS

THE SOLUTION of tough power piping problems—carrying big power around tight corners and through difficult situations—is a specialty with Power Piping Division. The enviable records of Blaw-Knox piping installations are explained only by the long experience of Blaw-Knox engineers, the skill and equipment available for handling complicated piping assemblies of all sizes in Blaw-Knox shops, and the excellent training and close supervision of Blaw-Knox field installation crews.

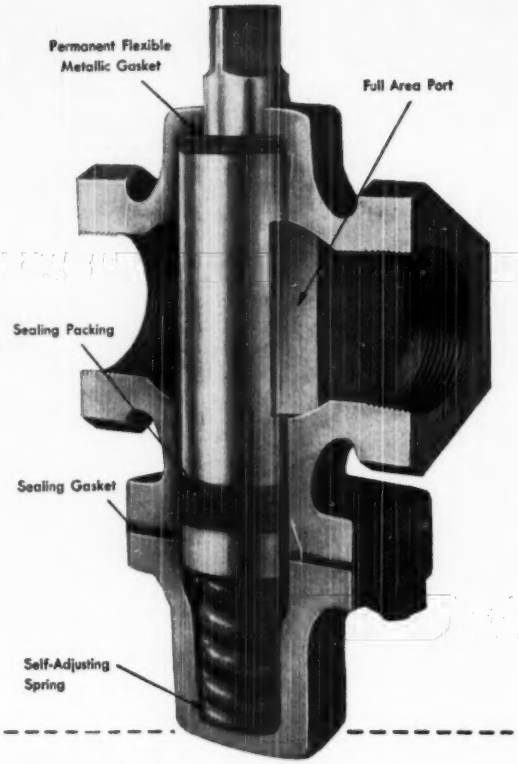
POWER PIPING DIVISION
OF BLAW-KNOX CONSTRUCTION CO.
1525 Pennsylvania Avenue • Pittsburgh 12, Pa.

BLAW-KNOX *Power-Piping*

NON-LUBRICATED

LEAK-PROOF

DROP-TIGHT SHUTOFF



The popular

HONEYWELL CYLINDRICAL PLUG VALVE

The Honeywell Cylindrical Plug Valve . . . incorporating many unique design features . . . gives dependable, maintenance-free operation.

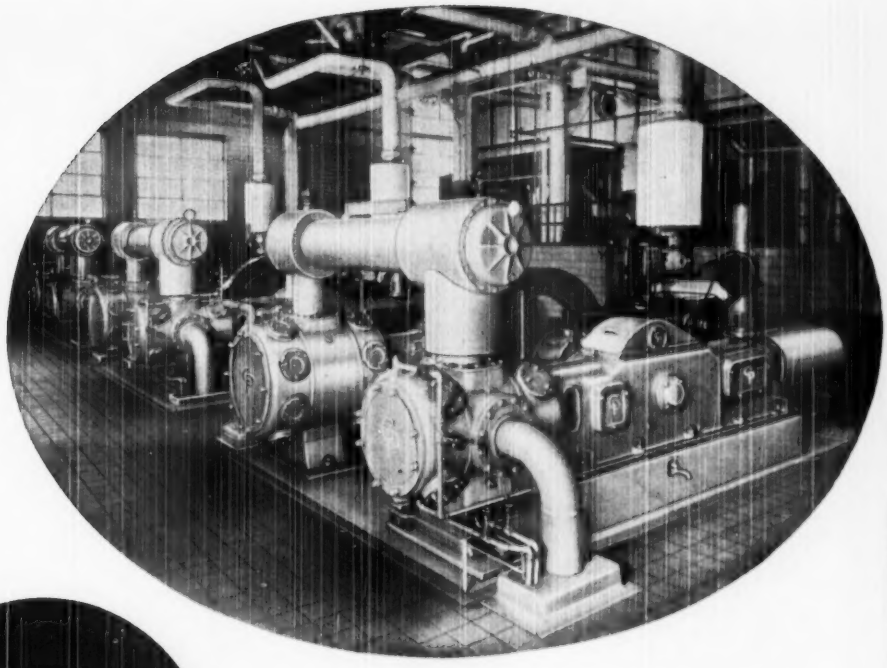
This is a compact, easy-to-operate plug valve which never requires lubrication . . . saving time and money. A special metallic gasket assures leakproof operation for the life of the valve. At a slight additional cost, a ground finish plug can be provided for drop-tight shutoff. For viscous fluids, spring housing can be tapped for steam line connection.

Call in your local Honeywell engineer for detailed information about the Cylindrical Plug Valve and such other Honeywell Process Control Specialties as: Transfer Valves, Liquid Level Devices, Hi-Lift Hand Control Valves and the Space-Saving Bypass.

COMMERCIAL • RESIDENTIAL • INDUSTRIAL
WORLD'S LARGEST ORGANIZATION FOR ADVANCED INSTRUMENTATION AND CONTROL

MINNEAPOLIS-HONEYWELL REGULATOR CO.
INDUSTRIAL DIVISION
1900 Windrim Avenue
Philadelphia 44, Pa.
Offices in 77 principal cities of the United States, Canada and throughout the world

Honeywell PROCESS CONTROL SPECIALTIES



low cost air where steam is available

In plants with ample boiler capacity, compressed air requirements can be met effectively, at low cost, with the Chicago Pneumatic Type H Steam-Driven Compressor.

Of horizontal duplex design, its dependability and economy over a wide range of operating conditions are assured by such features as: (1) economical steam end proportioned to the plant's steam conditions; (2) automatic cut-off governor; (3) efficient air end, with Simplate valves.

Capacities of the Type H range from 900 to 7400 c.f.m., 100 to 125 pounds pressure. Other sizes of CP steam-driven compressors are available in single and multi-stage designs for lower and higher pressures.

Write for Bulletin 729.

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(*a patented alloy*)

Only CHASE Antimonial Admiralty contains the *percentage* of antimony that has stood the test of time. Millions of pounds have been in use since 1935.

Admiralty with an antimonial content of less than .007% (the minimum set forth in Chase Patent No. 2,061,921) cannot be depended on to guard against dezincification under all conditions. For long life over a wide range of applications, the amount must be upped to about .015%. Chase boosts the nominal content to .035%—to be *sure* that even with normal commercial variation your tubes contain *at least* .015%!

Only Chase can make this patented Antimonial Admiralty. Get the facts today.

Special stocks of ANTIMONIAL ADMIRALTY Condenser Tubes in Chase Warehouses: NEW YORK, BALTIMORE, NEW ORLEANS LOS ANGELES, SAN FRANCISCO

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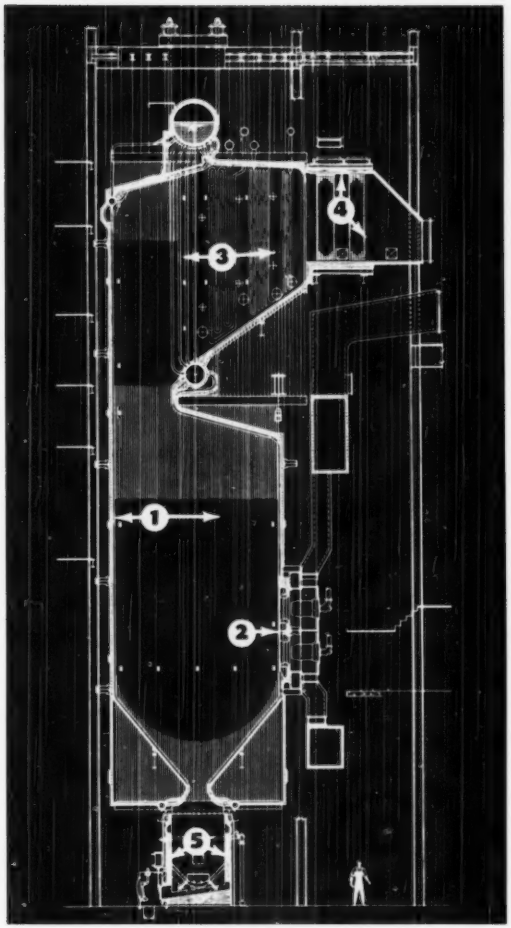


Above: Longitudinal section through boiler showing refractory details.

A Big Feather in the PLIBRICO Cap!

Plibrico enclosure for this 650,000 lb. boiler

The enclosure shown in the accompanying print is a big feather indeed. Its impressive size alone—106 ft. from basement floor line to center line of steam drum—is sufficient reason for being proud of the part Plibrico refractory products and engineering are playing in its erection.

The entire enclosure for this new boiler, rated at 650,000 lbs. steam per hr., is monolithic Plibrico construction varying in different sections to meet specific requirements. The result throughout is an air-tight enclosure which will give the most satisfactory refractory service with highest combustion efficiency.

Your boilers may not be rated as high as 650,000 lbs. steam per hr., but remember that Plibrico construction is equally at home in connection with all types of boilers and fuel-burning equipment. Plibrico Jointless Firebrick (made in four grades) is particularly suitable for monolithic linings, air-cooled walls, suspended arches. Plicast castable refractory material (11 grades) is ideal for ashpit linings, convection sections, tube decks, special shapes, etc. We also design and install Beco-Turner baffles for water tube boilers.

Whatever your refractory requirements, call upon your local Plibrico Sales & Service organization. They offer you competent application service, also expert installation and construction where desired. Write for catalog specifying water tube or fire tube edition.

1 PLICAST ENCLOSURE
for tangent tubes

The enclosure for the tangent tube water walls is a tube-suspended wall consisting of our Plicast castable refractory material, insulation, and welded steel casing. This completely air-tight construction eliminates the joints of ordinary tile construction, preventing any infiltration of excess air through the furnace enclosure and permitting proper control of combustion conditions.

2 PLIBRICO SUPER
for burner cones

Burner cones are constructed of Plibrico Super, our super-duty plastic refractory material with 100% flint clay base for severe service conditions. This material offers high resistance to extreme temperatures and thermal shock. Plicast castable refractory material is used to back up the nested tubes between the burners.

3 PLICAST LINING
in convection section

In the convection section the water wall tubes, spaced on 6 in. centers, are backed up with a tube-suspended enclosure consisting of Plicast castable refractory material, insulation, and steel casing.

4 PLICAST ROOF
over economizer

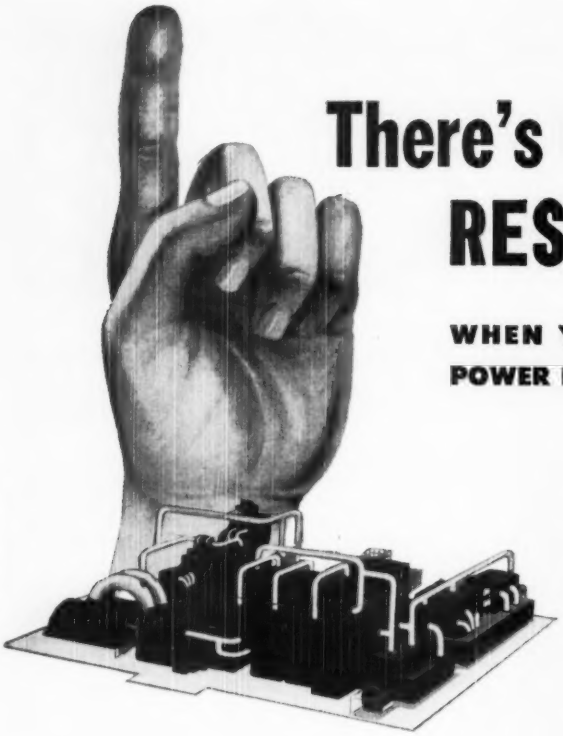
The economizer roof is constructed of Plicast castable refractory material suspended from steel supports by means of high-temperature alloy hangers.

5 PLICAST HYDRO-MIX
for ashpit lining

This material is manufactured especially for hydraulic ashpits where high refractoriness must be combined with maximum resistance to moisture as well as abrasion.

PLIBRICO JOINTLESS FIREBRICK CO., 1804 Kingsbury St., (Dept. C), Chicago 14, Ill.

PLIBRICO *Furnace* ENCLOSURES



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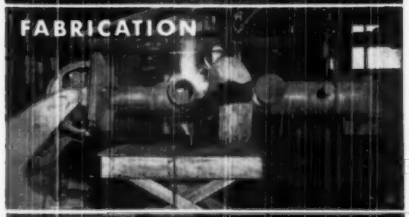
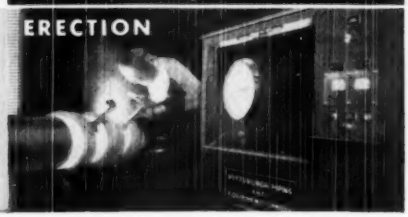
WHEN YOU TURN THE COMPLETE POWER PIPING JOB OVER TO P.P.&E.





Simplify responsibility on your next power piping installation—entrust the complete job to P.P.&E. These are a few of the advantages:

- Far less detail work for you.
- Correct interpretation of blueprints.
- Efficient detailing of shopwork for best coordination with field requirements.
- Maximum amount of system prefabricated, stress-relieved, model tested, as well as tested under ideal shop conditions.
- Field erection supervised by specially-trained personnel with a minimum of waste motion.

All these responsibilities—and many others—are made into one . . . *ours* . . . when the *complete* high pressure piping contract is turned over to us. Consult our nearest representative for futher information.

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The same engineering talent and manufacturing facilities that produced these turbines are available to assist you in obtaining efficient power generation.

Any of our District Representatives will be pleased to give you full information on a turbine drive for your requirements. No obligation. May we send you descriptive bulletin?

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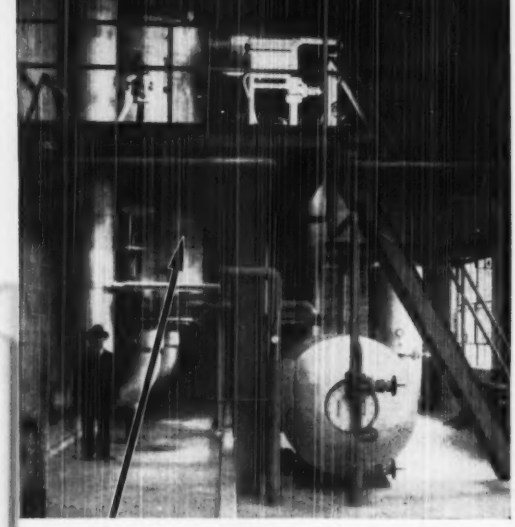

MAXIM HEAT RECOVERY SILENCERS

produce steam for plant heating and for sale to nearby customers

Close-up view showing two BVS Heat Recovery Silencers at New Prague; accumulator tank in left foreground.

The municipal power plant at New Prague, Minnesota makes good use of Maxim Heat Recovery Silencers. Waste exhaust heat that would normally go up the flue is used as it passes through the heat recovery silencers to produce usable and salable steam. The steam in this case is used for heating the plant itself, and surplus is sold for heating nearby homes, stores, and a factory.

Thus the New Prague municipal plant achieves effective and very necessary silencing of exhaust noise, but makes this silencing pay for itself many times over.

More and more industrial users, long accustomed to the necessity of effective silencing, are now realizing the profit possibilities of installing heat recovery silencers to produce steam for heating or processing operations, and without any extra fuel cost.

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COMPACT OVERALL DESIGN—size for size, these valves are more compact than the usual high-pressure design—at no sacrifice of strength.

TIGHT UNION BONNET JOINT—heavy steel union ring with long, precision-cut threads pulls up easily, stays tight, protects against distortion when joint is opened. Male and female bonnet joint with soft iron gasket eliminates possibility of gasket blowout.

LEAKPROOF BODY SEAT RINGS—are securely rolled into the body. No danger of leakage around ring. Cannot loosen in service.

FULLY GUIDED SOLID WEDGE DISC—cannot get out of line or jam in body. Disc drag and wear on seating surfaces are minimized.

GET DESCRIPTIVE FOLDER AD-1741 for more data on these valves. Gives sizes, dimensions, and service recommendations. Ask your Crane Representative for a copy or write direct. These valves also listed in your Crane No. 49 Catalog, P. 223.

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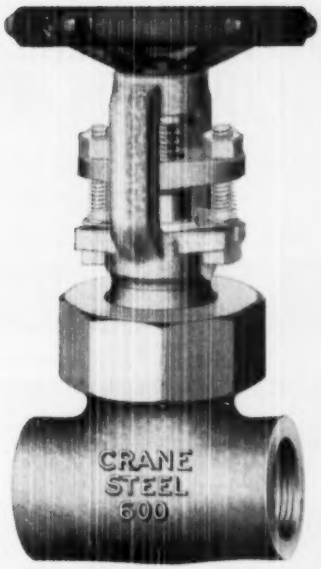
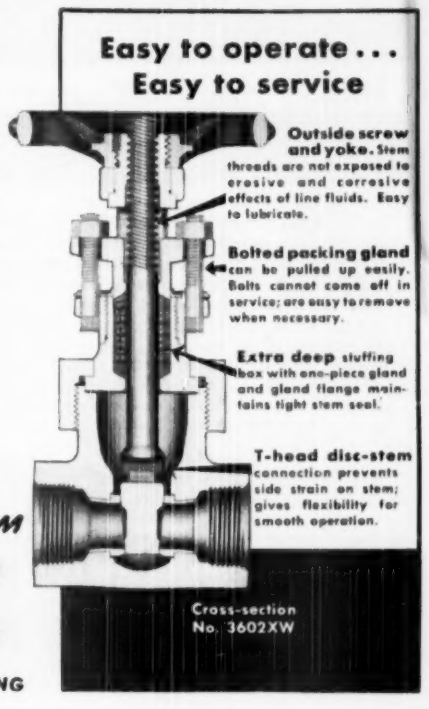


No. 3602XW, 600-Pound Small Steel Gate for steam up to 850° F; for water, gas, air up to 500° F. Hardened stainless to Exalloy Seating. Sizes: ¼ to 2-inch. Screwed or welding ends.


Easy to operate . . .
Easy to service
Outside screw and yoke. Stem threads are not exposed to erosive and corrosive effects of line fluids. Easy to lubricate.
Bolted packing gland can be pulled up easily. Bolts cannot come off in service; are easy to remove when necessary.
Extra deep stuffing box with one-piece gland and gland flange maintains tight stem seal.
T-head disc-stem connection prevents side strain on stem; gives flexibility for smooth operation.
Cross-section
No. 3602XW

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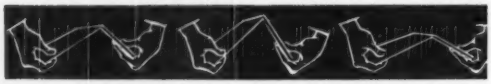
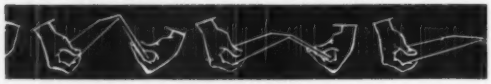
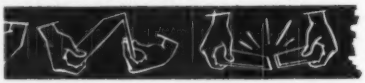
Flex . . . metal . . . *like* . . . *this*



. . . and . . . something's . . .

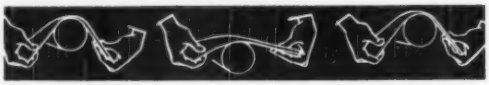


bound . . . to . . . *"give"*



Do . . . it . . . *like* . . . *this* . . . and

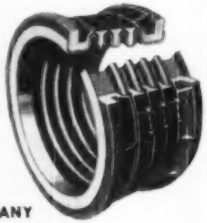
. . . you . . . can . . . go . . . *on* . . .



***and* . . . *on* . . . *and* . . . *on* . . .**

Yes, it's a simple principle, one you know — and one you should keep in mind when buying an expansion joint. For this is, in fact, the principle underlying the all-curve construction of a Badger Directed Flexing Packless Corrugated Expansion Joint. As the illustration shows, the movement of the corrugated member of a Badger Joint is controlled and contained so that it *always follows a curved pattern* . . . no corners or angles where stresses can localize . . . no excessive strain . . . no chance of breakdown.

For economy's sake remember this important feature when you specify . . . remember that it's found *exclusively* in Badger Directed Flexing Packless Corrugated Expansion Joints.



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ANTI-FOAM
KEPT THIS PIPE
FREE FROM SCALE

DEARBORN POLYAMIDE ANTI-FOAMS REDUCE FOAMING, KEEP VITAL STEAM LINES CLEAN

These are unretouched photographs of cutaway sections of superheater tubes. The bend at the left has a heavy scale deposit—the result of incompletely treated boiler water. The bend at the right was kept free from scale because the boiler water was treated with Dearborn Polyamide Anti-Foam 659.

This recent Dearborn development reduces foaming . . . prevents carry-over and consequent deposits of scale which may foul superheater tubes, turbine blades, valves and cylinders . . . conditions sludge . . . is compatible with other boiler water treatment.

If you use steam—in the operation of your plant or in the manufacture of your product—it will be worth your while to investigate Dearborn Polyamide Anti-Foam and other Dearborn water treatment service. The broad experience of Dearborn . . . gained by serving industry since 1887 . . . is immediately available to you.

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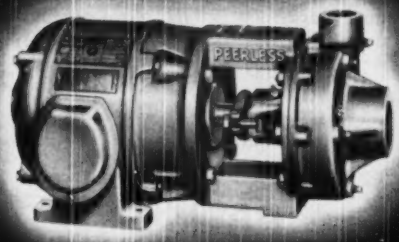
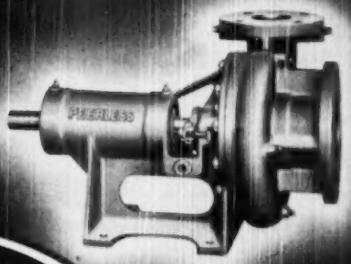
THE PEERLESS *Fluidyne* LINE

CLOSE-COUPLED TYPE
Integral H. P.



Type PE MOTOR SIZE: 1-40 H.P.
CAPACITY: Up to 5500 gpm
HEADS: Up to 270 Feet

BELTED OR DIRECT-CONNECTED TYPE *Integral H. P.*



Type PB MOTOR SIZE: 1-40 H.P.
CAPACITY: Up to 5500 gpm
HEADS: Up to 270 Feet

PEERLESS PUMPS

COMPLETE RANGE OF SIZES FROM ¼ TO 40 H.P.

CAPACITIES: UP TO 5500 G.P.M. • HEADS: UP TO 270 FEET

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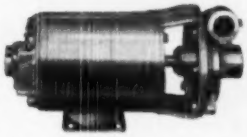
Both Type PE and Type PB Fluidyne pumps are single stage, end suction, centrifugal design. Simplicity and quality and ruggedness are inherent in their design. All parts are easily accessible. Close attention to hydraulic characteristics has resulted in pumping units of high efficiency. Disassembly and assembly for inspection or maintenance is rapid.

Fluidyne pumps operate with unimpaired efficiency in any position—vertical, horizontal or intermediate angle. All parts of exacting Peerless manufacture found only in highest quality pumps. Evidence of their high quality is found in features such as high strength cast bronze streamflow impellers, replaceable bronze wear rings on pump case, oversize packing, drain pocket, ball bearings (PB unit), precision alloy steel shafts.

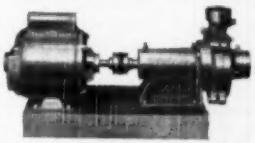
You can probably visualize a score of uses for these dependable, economical pumps. Write today for bulletins describing and illustrating Peerless Fluidyne pumps in the size and type you require.

FRACTIONAL HORSEPOWER CLOSE-COUPLED TYPE PE



¼ to 1 h.p. • 3450 rpm • 60 cycle
Capacity: To 50 gpm • Heads: To 93 Ft.

DIRECT OR BELTED TYPE PB FRACTIONAL HP COMMON BASE



¼ to 1 h.p. • 3450 rpm • 60 cycle
Capacity: To 50 gpm • Heads: To 90 Ft.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION

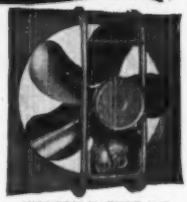
Factories: Los Angeles, California, and Indianapolis, Indiana
Offices: New York, Atlanta, Fresno, Los Angeles, Chicago, St. Louis, Phoenix, Dallas, Plainview and Lubbock, Texas.

—MOST COMPLETE LINE FOR '50!

CHELSEA FANS

—for every industrial and commercial requirement!

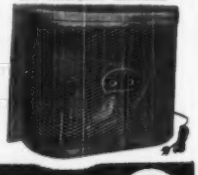
Specifying Chelsea Fans for every installation is one sure way to proper ventilation. There's a Chelsea model for every requirement and each type is certified as to performance in accordance with Standard Code of the Propeller Fan Manufacturers Association.



ALL-PURPOSE FAN TYPE BD
For removing smoke, steam, heat, fumes, etc. Heavy duty, direct drive fan for continuous operation. Recommended for use against static pressure and in dust work. One piece panel and orifice. Light-weight, simple to install. Sizes from 10" to 36".

INDUSTRIAL TYPE IND
For large general area ventilation. Moves large volumes at low pressure, overcoming high resistance in hoods and ducts. "V" belt drive; Sizes from 24" to 60".

SPIN-IT-FANS. 16" and 22"
A new idea in window fans—reversible for drawing-in or exhausting air. Two speed, for cooling and ventilating, and subsequent operation.



SEND FOR YOUR FREE KIT!
Contains all the information you need to make ventilating and cooling installations in factory, store, office or home; selection of proper fan, installation hints, etc. No obligation—write Department H.

CHELSEA FAN & BLOWER CO., INC.
1206 GROVE ST. IRVINGTON, N. J.
CHELSEA

New Printings Available

STEAM TURBINES

•

STEAM GENERATION

Because of continuing demand for these comprehensive and authoritative special sections, we have just made an additional printing and can now supply new orders. Price remains the same: 60¢ for single copies, 51¢ for 100 or more, 46¢ for 500 or more, 41¢ for 1000 or more, and 37¢ for 2000 or more.

Address your orders to:
Editorial Dept.

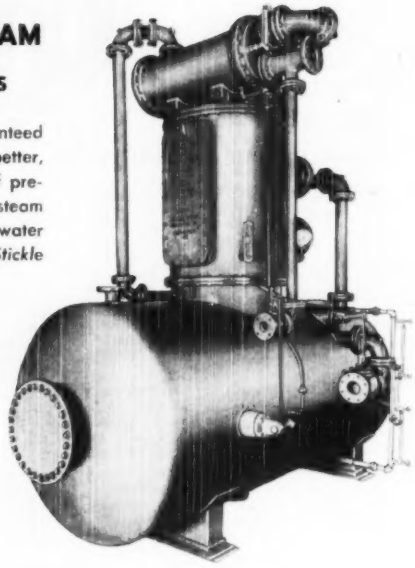
POWER

330 W. 42nd Street, New York 18, N. Y.

CUT COSTS FOR FUEL AND STEAM

WITH STICKLE OPEN COIL FEED WATER HEATERS

Stickle Open Coil Feed Water Heaters are sold only where guaranteed results are possible. The savings in fuel costs amount to 15% or better, depending upon the particular installation, but the advantages of preheating the boiler feed water are numerous and well known to steam engineers in all types of industries. . . . Many types of feed water heaters are available, but well authenticated figures prove that *Stickle Open Coil Heaters* heat more water in less space and at lower cost than any other heaters on the market. These economies, proved in hundreds of installations, are due to *Stickle exclusive open coil design*, which provides greater heat-transmission surface, and conserves all steam condensed in heating make-up water for boiler supply. There's a type and size to meet your needs. Write today for new Bulletin 117.



STICKLE EQUIPMENT

Cast iron or steel construction. Deaerating and non-deaerating types. Small to large capacities. Standard storage or built to meet large storage requirements.

STICKLE STEAM SPECIALTIES CO. 2265 VALLEY AVENUE INDIANAPOLIS, INDIANA

SEARCHLIGHT SECTION

EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

UNDISPLAYED RATE
(Not available for equipment advertising)
$1.20 a line, minimum 4 lines. To figure advance payment, count 5 average words as a line.
INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of rate, payable in advance.
PROPOSALS, $1.20 a line an insertion.

INFORMATION

BOX NUMBERS in care of any of our New York, Chicago or San Francisco offices count 1 line additional in undisplayed ads.

DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED RATE:

The advertising rate is $10.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns — 30 inches—to a page.

NEW ADVERTISEMENTS received by April 7th will appear in the May issue, subject to limitation of space available

MECHANICAL OR ELECTRICAL ENGINEER

Mechanical or Electrical Engineer about age forty-five needed to supervise Utility Company's Steam Generating Stations having a total capacity of approximately 200,000 kilowatts and located in Middle Atlantic area. Applicant must have technical education and broad generating experience, with ability to supervise, engineer and operate modern Stations.

Submit complete resume of personal background, education, experience and salary expected.

P-2289, POWER
330 W. 42nd St., New York 18, N. Y.

To EMPLOYERS who advertise for MEN:

Frequently, when there are many applicants for a position, only the most promising letters are acknowledged. The other applicants never know whether their letters reached a prospective employer or not. These men often become discouraged, will not respond to future advertisements and even question their bona fide character.

Every advertisement printed in the Searchlight Section is duly authorized.

You can help keep our readers interested and get better returns to your advertising in this section if you acknowledge each reply — in plain envelopes, if you wish.

Classified Advertising Division

McGRAW-HILL PUBLISHING CO., INC.

"Put yourself in his place."

ELECTRICAL ENGINEER

Fox River Valley (Wis.) paper mill wants electrical engineer experienced in all phases of maintenance and layout. Give complete personal and business history in letter of application. Write

P-2403, POWER
520 N. Michigan Ave., Chicago 11, Ill.

REPLIES (Box No.):
Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

WANTED CHIEF ENGINEER: Public utility in western Ohio has immediate opening for chief operating engineer of steam-electric plant. Technical graduate or equivalent with experience in operation and maintenance of modern steam plant equipment. Submit record of training ad experience and if interesting to us personal interview at our expense will be arranged. All replies held in strict confidence. Address P-1984, Power.

GRADUATE MECHANICAL Engineer to assist superintendent of production for public utility located in Ohio. Minimum experience of three years in steam plant operation required. Age 30-35, preferred. Permanent position with good future for qualified man. Give full outline education, work and personal references, salary expected. All replies confidential. P-1985, Power.

WANTED: MECHANICAL engineer for consulting engineer's office in Northwest. Work includes power plants, industrial piping, heating, ventilation and plumbing. Permanent position for right man. Graduate engineer under 45. Capable of proceeding with minimum supervision. State experience and references in detail, also salary required and when available. P-2468, Power.

ASSISTANT POWER House Engineer—Industrial plant in Tidewater Virginia has immediate opening for assistant engineer in steam-electric plant, 400 pound steam, 10,000 KW generating capacity. Some knowledge of refrigeration desirable because of plant expansion. Give full outline education, work, and personal references, salary expected. P-6046, Power.

SELLING OPPORTUNITIES OFFERED

SALES ENGINEERING Agent wanted. Expanded coverage desired by quarter century pump equipment manufacturer. Midwest western refinery and industrial sales organizations with good contacts. Write RW-2501, Power.

PROMINENT MANUFACTURER of centrifugal pumps desires to receive applications from manufacturer's agencies capable of giving aggressive sales representation to an extensive line, well cataloged and complete (does not include boiler feeders). Open territories are: Bangor, Charlotte, Cincinnati, Columbus, Des Moines, Harrisburg, Helena, Jacksonville, Little Rock, Memphis, Milwaukee, Norfolk, Peoria, Reno, Richmond, Scranton, Springfield, Mass., Toledo, Wichita, Wilmington, Del., Youngstown. Reply RW-2458, Power.

EMPLOYMENT SERVICES

SALARIED PERSONNEL $3,000-$25,000. This confidential service established 1927, is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 2451 Orange St., New Haven, Conn.

Engineers — Executives — Technical Men
Salaried Positions, $4,000 to $30,000
This Confidential service for men who desire a new connection, will develop and conduct preliminary negotiations without risk to present position. Send name and address for details.

TOMSETT ASSOCIATES
1205-2 Berger Bldg., Pittsburgh 19, Pa.

EMPLOYMENT SERVICES

SALARIED POSITIONS $3,500-$35,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (40 years recognized standing and reputation). The procedure, of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 270 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

POWER PLANT Supervisor, technical school graduate, 7 yrs. of power plant operation and maintenance experience. Also some refrigeration. Age 28 yrs. PW-2396, Power.

WANTED: EMPLOYER; to submit qualifications; to a practical operating engineer; who desires position as Assistant Chief Eng. State salary; benefits; security; future. PW-2366, Power.

REBISTERED ENGINEER ASME. 58, 12 years experience, automatic fired water and fire tube package steam generators wishes responsible position development or field. Present earnings $10,000.00 PW-2464, Power.

POWER ENGINEER—Twenty-five years experience, operation and maintenance of modern power plants, electrical equipment, refrigeration, air conditioning and water filtration plants. Fifteen years high pressure plant, some construction experience, desire supervisory-engineer position with a utility, industrial plant or municipality. Registered engineer, gold seal licensed power plant operator. Will relocate or travel. PW-2313, Power.

SELLING OPPORTUNITY WANTED

NEW YORK Sales organization with six sales engineers needs a superior instantaneous steam water heater or other heat exchanger for all or part of Southern and Central New York State and New Jersey. Now selling steam traps, control valves, etc., to industrials, utilities and institutions. RA-2267, Power.

SALESMAN—EXPERIENCE selling steam specialities, fluid and automatic controls. Desires connection with manufacturers or manufacturer's representative. RA-2465, Power.

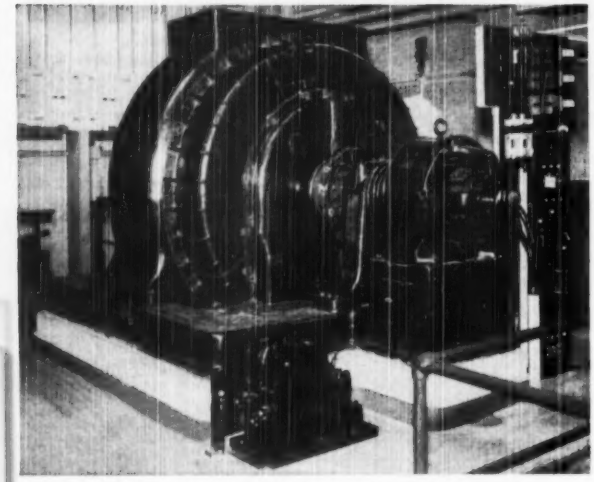
INDUSTRIAL SALES Coverage—N. Y.—N. J.—Conn. Your product can be sold and serviced through a manufacturing organization established for over 25 years. Use our Selling Sales Engineers to cover this area. For complete information, RA-2500, Power.

ESTABLISHED MANUFACTURERS' Agent wants specialty in power, electrical refrigeration or air conditioning field to sell industrial plants within 75 mile radius of Philadelphia. RA-6018, Power.

WANTED

ANYTHING within reason that is wanted in the field served by Power can be quickly located through bringing it to the attention of thousands of men whose interest is assured because this is the business paper they read.

Generate Your Own Power With "UTILITIES APPROVED" EQUIPMENT



Actual Photograph

SYNCHRONOUS CONDENSER OR MOTOR

5000 KVA Westinghouse Electric Corporation 3 phase 60 cycle 4000 volt, 725 amperes, 720 RPM synchronous condenser Serial #4240814 equipped with a 125 volt, 280 amperes, Type SK, 720 RPM direct connected exciter, switchboard and instruments. Can be converted as a *synchronous motor* developing 4000 HP, at either 80 or 100% P.F.

EXCELLENT CONDITION — COMPLETE INSTALLATION — PROMPT DELIVERY

TURBINE-GENERATOR UNITS

3 phase, 60 cycle

6250 KVA G. E. condens., 5 stage, 2300/4000 volts, 200# pressure, 600°TT, 3600 RPM.

5000 KVA G.E., non-cond. Automatic Extraction, 13,800 volts, 600# P.S.I. 750° TT 150# extraction and 25# gauge back.

3125 KVA G.E. condens. 130 P.S.I. 550 volts.

3125 KVA G.E. condensing 175/200 P.S.I., 2300 volt, 500° TT, 3600 RPM complete.

1875 KVA G.E. non-condensing 250# pressure, 30—50# gauge back, 480 volts, 3600 RPM

1563 KVA G.E. non-condensing 250 P.S.I. 25# gauge back, 2400 volts, 3600 RPM.

1563 KVA G.E. condensing 250 P.S.I. 2300 volts, 3600 RPM complete.

1560 KVA Allis condens. bleeder, 180-200 P.S.I. extraction 25,000# per hour, 240 volts.

1250 KVA Allis non-condensing 150 P.S.I. 10# gauge back 240/480 volts.

937 KVA Allis non-condensing 125 P.S.I. 10# gauge back 480 volts.

925 KVA G.E. non-condensing 150 P.S.I. 15# gauge back, 480 volts, 3600 RPM.

625 KVA Westinghouse condensing 150/200# pressure, 2300 volt, 3600 RPM complete.

625 KVA G.E. non-condensing 150# pressure 15# back, 2300 volts, 3600 RPM complete.

375 KVA (4) G.E. condensing 400# pressure, 480/600/2300/4150 volts complete.

112 KVA G.E. non-condensing 125# pressure 10# gauge back 480 volts.

100 KVA Westg. non-condensing 125 to 150# pressure, 10# gauge back, 2400 volts.

TURBINE-GENERATOR UNITS

Direct Current

400 KW (2) 240 volts direct current Crocker-Wheeler Worthington 440 lbs. condens.

150 KW (2) 3 wire, 250 volts, 225/250 P.S.I. Westinghouse-Worthington condensing.

75 KW Allis-Chalmers-Terry, 125 volts, 2400 RPM, 150# pressure non-condensing.

75 KW (2) Westinghouse-Moore 120 volt, 200# pressure, condensing.

60 KW (3) new Westinghouse 120 volt, 200# pressure, condensing.

SYNCHRONOUS MOTORS

3 phase, 60 cycle

5000 KVA Westghse. 4000 volt. 720 RPM

900 HP Allis, 2200 volts, 150 RPM

750 HP G.E. 2300 volt, 720 RPM

300 HP 80% P.F. G.E. 2300 volts, 720 RPM

MOTOR GENERATOR SETS

500 KW General Electric 600 volt DC, direct connected to 710 HP, 3 phase 60 cycle, 2300 volt, 720 RPM synchronous motor.

400 KW General Electric 275 volt DC, direct connected to 710 HP, 3 phase 60 cycle 2300 volts, 720 RPM synchronous motor.

300 KW Allis-Chalmers, 250 volts DC generator direct connected to a 430 HP Allis-Chalmers 3 phase 60 cycle, 440 volt, 1200 RPM synchronous motor.

150 KW G.E. 125 volt direct current generator direct connected 225 HP, 3 phase 60 cycle 220 volt, 1200 RPM synchronous motor.

62½ KVA G.E., 3 phase 60 cycle, 2300 volt, 1200 RPM alternator direct connected 75 HP, 125 volt DC motor.

STEAM ENGINE-GENERATOR UNITS

Direct Current

400 KW G.E. 240 volts, 360 RPM generator connected Skinner Unaflow vertical engine 150#, 10# gauge back.

275 KW Westinghouse 250 volt, generator connected Ames vertical Unaflow engine.

250 KW (2) G.E. 3 wire 250 volts generators connected Skinner Unaflow Engines.

100 KW Burke 3-wire, 250 volt generator connected Skinner Unaflow engine.

30 KW (2) G.E., 125 volts, 425 RPM generators each direct connected G.E. vertical engine 125 P.S.I.

STEAM ENGINE-GENERATOR UNITS

Alternating Current—3 phase, 60 cycle

1125 KVA—G.E. 480 volts, 150 RPM generator direct connected 28"x36" Nordberg Unaflow non-condensing engine 150-200# pressure, 5-15# gauge back.

625 KVA Westinghouse 240 volts, 150 RPM generator connected 28"x36" Skinner Unaflow Engine 125 P.S.I.

375 KVA G.E. 2300/440 volts, generator connected 23"x24" Skinner Horizontal Unaflow Engine 120—150 P.S.I.

175 KVA G.E. 240 volt generator connected Skinner Horizontal Unaflow Engine.

MARCH BARGAINS

1—New 8400 sq.ft. Ingersoll-Rand Horizontal surface condenser.

1—4400 sq.ft. Worthington surface condenser.

4—900 KW, 250/375 volt, 720 RPM Elliott direct current generators direct connected 1200 HP, 8 cylinders Model #3BD8-½ opposed piston, 720 RPM Fairbanks-Morse Diesel Engines.

1—5425 GPM, 70 foot head Worthington Centrifugal pump direct connected to 125 HP G.E. 3 phase 60 cycle, 2200 volt, 1750 RPM G.E. slip ring motor.

2—1000 GPM, 1270 foot head, 4-stage, Morris Machine Works pumps each direct connected to a 417 HP, 3-stage, Form D-54, 3100 RPM 390# pressure non-condensing G.E. steam turbine.

UMC UTILITIES MACHINERY CORP.

1965 EAST 6th STREET • CLEVELAND-14, OHIO • Long Distance 422

GLOW ELECTRIC CO.

SQUIRREL CAGE MOTORS

HP	RPM	Volts	Make
750	900	6600	Westgh
350	3550	2200	Westgh-CS
300	1800	440	Al-Ch
300	900	440	GE-I-17
300	514	440	GE-I
250	1200	440	GE-KTR
250	600	2300	Triumph
225	514	440	GE-I-14
200	490	2200	GE
200	600	440	Westgh-CS
150	600	2200	GE
125	3600	220/440	Al-Ch AN
125	1200	440	Century
125	340	220	A-C
85	3600	2200	GE
75	1200	220/440	GE-K505Y
90	3600	2300	GE-KT
80	1800	440	Lincoln
60	1800	2300	GE-FTR
50	1800	220	Triumph
50	1200	220/440	GE-Tri-Clad
50	900	220	GE
50	720	2300	Wtg-CS
40	1200	550	A-C AN
40	1200	220	GE-KT
40	900	2300	Wtg-CS
40	900	220	Lincoln
40	720	440	GE-KT
35	1800	220	GE type I
35	600	440	GE type I Form M
30	1200	dual	Master
30	900	220	Lincoln
30	900	220	Wagner (Hi-Torque)
30	720	220	GE-HJ
30	514	440	Stanley
25	3600	dual	L-A
25	1800	220	L-A, HD
25	1200	220	Wesche
25	1160	208/416	Wtg-CS
25	900	440	GE
25	690	220	Westgh, type CS
25	575	220	GE-type M
20	3500	440	Al-Ch
20	1800	220/440	GE-K
20	1200	208/416	GE-KGff

ENCLOSED SQUIRREL CAGE

HP	RPM	Volts	Make
125*	1200	440	GE-TE-FC-BB
75	1200	2200	GE-TE-FC-BB
60	900	440	GE-TE-FC-BB
30	900	440	Reliance, TE-FC-BB
20	3600	dual	Delco-TE-FC-BB
20	1200	440	Wagner
20	900	440	GE-TE-FC-BB
15	1200	220/440	Delco-TE-FC-BB
15	900	440	GE-TE-FC-BB
10	3600	220/440	F-M
10	1200	440	GE-TE-FC-BB
7½*	1800	dual	Wagner-TE-FC-BB
7½*	1800	dual	Master-TE-FC-BB
7½	1200	dual	GE-Hi Slip-TE-BB
7½	1200	dual	Delco
7½	1090	220/440	GE-Hi Slip
7½	900	dual	Delco-TE-FC-BB
5	3600	dual	Delco-TE-FC-BB
5*	1800	dual	Master-TEI-C-BB
5	1800	220	Wagner-TE-B-BB
5*	1200	dual	GE-TE-FC-BB
3	3600	dual	Delco-TE-FC-BB
3	1800	dual	Delco-TE-FC-BB
3	1200	440	GE-TE-FC-BB
3	900	dual	Delco
2	1800	dual	Delco-TE-FC-BB

*New Motor

ENCLOSED SQUIRREL CAGE Cont'd.

HP	RPM	Volts	Make
½	1200	220	GE-TE-BB
½	900	220	Wagner-TE-BB
½	1800	dual	L.Al-TE-BB
½	1200	dual	Delco-TE-FC-BB
½	900	dual	Delco-TE-FC-BB
1	3600	220	Haskins-TE-FC
1	1800	dual	Master-TE-FC-BB
1*	1800	dual	Delco-TE-BB
1	1200	220	GE-KT
¾	3600	440	Delco-TE
¾	1800	dual	Weeche-TE-BB
¾	900	dual	Delco-TE-FC-BB
½	1800	440	Delco-TE-BB
½	1800	dual	Delco-TE-BB

SLIP RING MOTORS

HP	RPM	Volts	Make
500	900	440	GE-3 Rtg
400	1200	2300	Al Ch
375	1800	2300	Al Ch
350	900	2300	Westgh
300	720	2300	Al Ch
250	720	440	GE-MT
250	900	2300	Al Ch
235	1800	220	GE-I
200	1800	440	Al Ch
150	1750	440	GE-MT
75	1800	220	GE
75	900	440	Al Ch, ANY
75	720	2200	Wagner type BR
60	1800	dual	Al Ch
60	900	2300	Burke
60	900	220	Wesche
50	1800	220	GE-MT
50	900	2300	Ridgeway
50	900	440	Wagner
50	720	440	Al Ch
40	1200	220	GE-MT-336
40	900	220	A-C
40	720	2300	Wtg-HF
40	720	220	Al Ch-ARY
40	600	2300	Al Ch-ARY
40	600	220	Al Ch-ARY
40	450	220	Triumph-C
35	900	2200	GE
35	900	220	Al Ch
35	900	2300	Ridgeway
35	720	220	GE
35	570	450	GE-I
30	1800	2300	Wtg-CW
30	1800	2300	GE
30	1200	440	Wagner
30	900	220	GE-MT
30	600	220	F Morse-BV

VERTICAL MOTORS

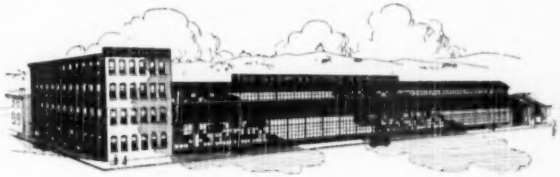
HP	RPM	Volts	Make
200	1200	440	Al Ch-SR
150	1200	2200	GE-I-SR
150	1200	440	GE-Cage
125	1200	2300	Al Ch-SR
125	1200	2300	Al Ch-Cage
100	1200	440	GE-Cage
75	1200	2200	GE-Cage
77½	900	220	Ideal-Cage]
60	1800	220 DC	GE
60*	1200	440	Al Ch-C

VERTICAL MOTORS—Cont'd.

HP	RPM	Volts	Make
50	1200	2200	Wtg-Cage
50	600	440	Al Ch-Cage
40	1800	220	GE-Cage
40	1700	230 DC	GE
40	1200	440	GE-SR
40	1200	2200	Westgh-BB-Cage
35	1200	2300	Al Ch-Cage
35	450	440	GE-Cage
30	1000	dual	Wtg-Cage
25*	1500	230 DC	GE
25	1200	2300	GE-Cage
25	850	230 DC	Wtg
20*	1200	440	Al Ch-Cage
20	800	230 DC	GE-RC
15*	1800	440	Al Ch-Cage
15	1750	110 DC	Wtg
15	1150	230 DC	GE
15	600	440	Al Ch
12½	900	220	L Al-Cage
10	3400	230 DC	Wtg
7½	1800	500 DC	Peerless
7½	900	440	Burke
7½	700	230 DC	GE
6	850	110 DC	Rel
5	1400	115 DC	R & M
5	600	440	GE-Cage
4	1650	110 DC	Watson
3	3600	dual	Delco
3	1700	230 DC	Watson
3	1200	dual	Wtg-Cage

SYNCHRONOUS MOTORS

HP	RPM	Volts	Make
3000	720	4800	GE-ATI
1015	900	2200	Wtg-25 cycle
710	720	13200/6600	GE
500	514	440	GE
435	720	2300	GE type ATI
330	900	2300	GE-ATI
280	1800	2300/4160	GE-ATI
280	225	2200	GE-TS
225	900	4100	GE-ATI
220	600	2300	GE-ATI
175	225	230	GE-TS (rotor & stator only)
160	600	440	GE-ATI
160	164	460	GE-TRP (rotor & stator only)
150	1800	2300	GE
150	1800	220	GE-ATI, single bearing
150	900	440	Star
150	720	440	Westgh
130	225	220	E-M, rotor & stator only
115	164	208	GE
100	1200	220	Wstg single bearing
98	1200	220	Burke
75	1200	220	Westgh
75	900	2300	GE-ATI-7552
60	360	2200	GE, rotor & stator
50	1200	440	Wagner
50	900	220/440	Westgh
50	720	440	GE-ATI
50	360	440	GE, rotor & stator
50	300	220/440	Wstg (rotor & stator only)
30	900	440	Wagner
30	600	550	GE, rotor & stator
30	450	dual	Wtg, rotor & stator
30	360	550	GE
30	327	220	E-M, rotor & stator
25	1800	220	Wagner
25	450	220	E-M, rotor & stator
20	1200	440	Wagner
20	900	220	Wtg
20	600	220	E-M, rotor & stator



D. C. MOTORS

115 Volts

HP	RPM	Description
225	750	GE-MPC
50	120	Al Ch
35	975	Northern
30	1800	F-M
30	200/600	Sprague
25	1150	Triumph
25	750	GE-A
20	700	Triumph
20	500/1500	GE-RPH
20	400/1200	GE-RLC fr 202A
18	600	Sturtevant MP8
15	1200	J & L
15	1000	GE-CE
15	975	F-M
15	725	Westgh-8 fr 6
12	1075	J & L
12	850	Westgh-8K-113
10	3450	Imperial
10	1700	Fairbanks-Morse
10	650	J & L, type CI
10	400/1600	Watson-FW15B

GEAR HEAD MOTORS

60 Cycle, A.C.

HP	Output RPM	Volts	Ph	Description
20/10	375/185	440	3	Master-Two speed motor
10	450	220/440	3	Master-Vertical
5	6550	220/440	3	Master-Parallel
5	300/1800	220/440	3	Delco-Variable Speed Transmission
3	300	220	3	GE-Parallel
3	315/1500	3	3	Master-Vari-Drive
2	623	220	3	Master, Parallel
2	315	220/440	3	Master, Parallel
2	281	220/440	3	Master, Parallel
1½	5.4	220	3	Janette, Rt Angle
1½	388	110/220	1	Master, Parallel
1	420	220/440	3	Master, Parallel
1	2.2 to 11	220/440	3	U.S. Varidrive
1	190	115/230	1	Master, Parallel shaft
½	143	220	3	Master, Rt Angle
½	190	220/440	3	Master-Parallel Shaft
½	269	440	3	Janette-Parallel Shaft
1/8	144	230	1	Master, Type RA
1/6	19	220/440	3	Master, PA-TE-BB
1/12	172.5	115	1	Westgh Rt Angle

D. C. GENERATORS

125 Volts

KW	RPM	Description
540	1000/1800	Westgh, single bearing
500	750	GE-MCF
300	1500	GE-CC
300	900	GE-MPC
200	800	GE-DMC
100	1000	GE-DLC
100	900	Westgh-8K single bearing
75	1000	GE-Type TD
35	1150	GE-DLC
35	2000	J & L
31.25	1400	Westgh-8K single bearing

D. C. GENERATORS

230 Volts

KW	RPM	Description
400	1200	Westgh, single bearing
200	1200	GE-MPC single bearing
175	450	Westgh
80	1200	Al Ch-E-127
30	1800	GE-RC
20	3600	Triumph
22½	765	Westgh-8K
20	1750	Delco Ballbearing
18	360	Burke
15	350	Westgh-8K

AC & DC MOTORS • GENERATORS • PUMPS
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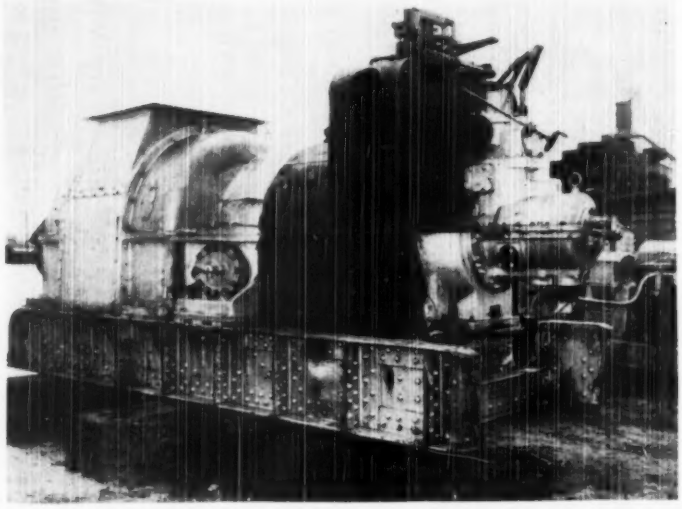
MOTOR GENERATOR SETS • ELECTRIC EQUIPMENT
STEAM ENGINE GEN. SETS • SLIP RING MOTORS

927 HARRIET ST.
PHONE MA. 3024
CINCINNATI 3, OHIO

IMMEDIATELY AVAILABLE

2500-KVA Westinghouse

Condensing Turbo-Generator: 250-psi 3/60/2300-v



The 2500-KVA., Westinghouse Condensing Turbo-Generator Turbine Serial 12567 illustrated above, is a high grade machine, in good condition, ready for installation. It is a complete unit with Westinghouse 2-pass Surface Condenser, with auxiliaries, Serial No. 2704, with Switchboard complete with all instruments, etc.

SPECIFICATIONS

Turbine		Generator	
Mfr.	Westinghouse	Mfr.	Westinghouse
Capacity	2500-KVA	Capacity	2500-KVA
Steam	250-psi	Frequency	3/60/2300-v
RPM	3600	RPM	3600
Vacuum	28"	Power Factor	100%
Frame	26-FCW	Amps	655
Serial No.	12567	Serial No.	4782722

OTHER TURBO-GENERATORS IN OUR STOCK

6250-KVA., G.E., 2300/4160v. Cond.
4375-KVA., G.E., Rebuilt: New Coils
3125-KVA., G.E., Complete, 250#
3125-KVA., West., 250#, 2300v. Cond.
2500-KVA., West., Non-C., 250# (2)
2500-KVA., G.E., 150#, Cond. 2300v
1875-KVA., G.E., 250-psi., No. 1 unit
1875-KVA., Allis-C., Cond., 200#, 2300v
1563-KVA., G.E., 200-psi, Non-C., 15/25-BP
1563-KVA., G.E., 225-psi, Cond., 2300v
937-KVA., G.E., 150-psi, Non-C., 480v, 15-BP
937-KVA., Allis-C., Cond., 480v
937-KVA., G.E., Cond., Rebuilt
625-KVA., West., Non-C., 300#-psi, 480v, 15/25-BP
625-KVA., G.E., Cond., 200-psi, 480v
625-KVA. (2), G.E., Non-C., 480v, 150#, 15/25-BP
625-KVA. (2), DeLaval-Allis, 125#, 480v, 15/25-BP

COMPLETE DATA ON REQUEST. PLEASE SEND SPECIFICATIONS FOR ANY ITEM WANTED NOT LISTED.

We Specialize also in Diesel Engines: Carry a Complete Line:
Send for Bulletins 320, 350 and 525. CORRESPONDENCE INVITED

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DEPENDABLE ELECTRICAL EQUIPMENT AT LOW COST

MOTORS . . . GENERATORS . . . M-G SETS

PUMPS . . . FANS . . . BLOWERS . . . SPEED REDUCERS

PARTIAL STOCK LISTING—WRITE, WIRE OR PHONE YOUR REQUIREMENTS

M-G SETS

KW	Mfr.	Input V	Output V
500	Whse.*	2300 AC	250 DC
300	Allis Ch.*	220/440 AC	250 DC
250	Gen.Elec.	440-25 Cycle	250 DC
200	Gen.Elec. b.b.	220/440 AC	250 DC
200	Ridgeway*	2300/4000 AC	550 DC
200	Gen.Elec.*	220/440 AC	125 DC
200	Reliance*	220/440 AC	250 DC
180	Gen.Elec.	220/440 AC	125/250 DC
150	Burke*	250/440 AC	250 AC
105	Century b.b.	220/440 AC	70 DC
100	Allis Ch.	220/440 AC	125/250 DC
100	Allis Ch.	2200 AC	250 DC
100	Gen.Elec.*	220/440 AC	125 DC
75	Cr.Wh. b.b.(2)	220/440 AC	250 DC
75	Star*b.b. NEW	220/440 AC	250 DC
50	Whse.	220/440 AC	250 DC
50	Gen.Elec.(2)	220/440 AC	125 DC
40	Northw'n Conv.	220 AC	230 DC
35	Gen.Elec.	220/440 AC	48 DC
32	Gen.Elec.	220/440 AC	180 cycle
30	Gen.Elec.	220/440 AC	250 DC
25	Gen.Elec.	220/440 AC	25 DC
20	Whse.	230 DC	110 AC
20	Star b.b.(2)	220/440 AC	250 DC
15	Gen.Elec.	220/440 AC	125 DC
10	Allis.Ch.(2)	220/440 AC	250 DC

*Synch. motor drive.

D. C. MOTORS

HP	Mfr	Type	Volts	Speed
200	Reliance	1970T	230	575/750
150	Whse.	SK201	230	300/900
150	Cr.Wheeler b.b.	52H	230	1200
150	Cr.Wheeler b.b.	TEFC	230	800
100	Whse.	SK181	230	450/900
100	Gen.Elec.	C	230	575/1000
100	Gen.Elec.	RC36	115	1150
75	Cr.Wh. NEW b.b.	TEFC	230	900
75	Allis Ch.	E-149	230	800
75	Northw'n	K20	230	1750
75	Cr.Wh. New b.b.	CMC-HH	230	1150
60	Whse.	SK143	230	1150
50	Burke b.b.	WA65	230	1750
50	Gen.Elec. b.b.	CDM	115	1150
40/60	Whse.(2)	SK170	230	500/1000
40	Sprague dyna.	LC	230	780/2000
40	Whse.(2)	SK130	230	950
33/50	Gen.Elec.	CD123	230	575/1150
35	Ideal	DV350	230	400/1200
30	Reliance b.b.(3)	230T	230	850
30	Whse.	SK93	230	1750
30	Whse.	S-7	115	900
25	Gen.Elec.	RC31	230	1150
25	Gen.Elec.	CD85	230	1750
20	Gen.Elec.	RF12	230	400/1600
20	Whse.	SK52	230	1150
20	Gen.Elec.	CD85	230	1150
20	Whse.	SK130	230	500/1500
20	Reliance b.b.	TE	230	850
15	Whse.(3)	SK90	230	825
15	EL Dyn. b.b.	326	230	1750
15	EL Dyn. b.b.	189	230	300/1200
15	Whse.(2)	SK80L	230	1150
15	G.E. TEFC b.b.	CD83	230	1750

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Reliance	1970T	250	720
150	Cr.Wheeler b.b.	TEFC	250	1200
125	Cr.Wheeler b.b.	52H	250	1200
105	Century b.b.	1500 amp.	70	1200
100	Gen.Elec.	RC17	125	1200
100	Gen.Elec.	C	250	750
100	Allis Ch. 3 wire	MCW,	120/240	1200
75	Cr.Wh. New b.b.(3)	HH	250	1450
75	Allis Ch.	E	230	780
75	Gen.Elec.(2)	RC36	125	1200
50	Whse.	SK	250	1200
50	Gen.Elec. b.b.	CDM	125	1450
40	Whse.	SK	250	1150
35	Northw'n	K	125	1150
30	Elec.Prod.(2)	BP	50	1150
25	Gen.Elec. b.b.	CDM96	25	1200
20	Whse	SK93	250	1750
15	Star b.b.(4)	SQ	250	1750

A. C. MOTORS—25 CYCLE

HP	Mfr.	Type	Volts	Speed
150	Whse.	HP	440	500
150	Gen.Elec.	UK-16	440	750
50	Gen.Elec. Int.	MTC5337	440	750
50	Gen.Elec.	I-K	440	750
50	Gen.Elec.	KT339	440	1800
40	Gen.Elec.	KT343	440	750
20	Gen.Elec.	KT327	440	750

A. C. GENERATORS—60 CYCLE

KVA	Mfr.	Type	Volts	Speed
625	Gen.Elec.	ATB	2300	450
375	Gen.Elec.	ATB7567	240/480	1200
300	Gen.Elec.	ATB	240/480	720
250	Whse.	G	2400/480	600
225	Gen.Elec.	ATB	240/480	600
187	Gen.Elec.(2)	ATB	240/480	900
180	Gen.Elec.	ATB	240/480	900
125	Gen.Elec.	ATB	240/480	720
125	Gen.Elec.	ATB	240/480	300
56	Gen.Elec. (2)	ATB	240/480	1200
56	Gen.Elec.	ATB	240/480	900
31	Gen.Elec.	AT17836	240/480	1200
31	Whse.b.b.	G	120/208	1200
25	F.Morse	AB	230/440	1800
25	Whse b.b.	1 ph.	120/240	900

A. C. MOTORS—SLIP RING

3 Phase 60 Cycle 220 or 440 Volts

Qu.	HP	Mfr.	Type	Speed
1—	600	Gen.Elec.	I-M	360
1—	500	Allis Ch.	ANY	450
1—	400	Gen.Elec. 2300V.	IM-EB	1800
2—	300	Allis Ch. 2200V	ANY	720
1—	300	Gen.Elec. 2200V.	I-M	1800
1—	250	Gen.Elec.	I-M	600
1—	250	Allis.Ch. 2200V.	ANY	514
1—	200	Gen.Elec.	I-M	360
1—	200	Gen.Elec.	I-M-17	600
1—	200	Gen.Elec. 2200V.	I-M-17A	450
1—	200	Allis Ch. 2200V	ANY	720
1—	150	Gen.Elec. 2200V.	I-M-16	600
1—	150	Whse.	MW	430
1—	150	G.E. 2200/4000V.	I-M	1200
1—	150	Allis Ch.	ANY	660
1—	100	Gen.Elec.	MT356	900
1—	100	Gen.Elec.	I-M	720
1—	100	Allis Ch.	ANY	1800
1—	100	Allis Ch. b.b. NEW	ARY	800
1—	75	Cont. b.b. New	SN564	1200
1—	75	Gen.Elec.	I-M-E13	1200
2—	75	Gen.Elec.	I-M-14	720
1—	75	Gen.Elec. int. duty	MTC5342	900
1—	75	Gen.Elec.	MT356	600
1—	75	Gen.Elec.	MT337	1800
1—	50	Allis Ch.	ANY	900
1—	50	Howell	SR437	1200
1—	50	Fair.Morse	BV	720
1—	50	Gen.Elec. int.	ITC5013	600
1—	50	Whse. int.	CI	600
1—	50	Gen.Elec.	I-M	720
2—	40	Gen.Elec. int.	MTC5526	900
1—	37	Gen.Elec. int.	ITC	900
1—	30	Lincoln		900
1—	30	Lancashire b.b.		1800
1—	30	Gen.Elec.	OMT336	1200
1—	30	Gen.Elec.	MT346	600
1—	25	Whse.	CW	1200
1—	25	Gen.Elec.	MT336	900
1—	25	Triumph	SR	1200
1—	25	Gen.Elec.	I-M	600
3—	20	Gen.Elec. int.	MTC5512	900
1—	20	Gen.Elec.	MT303	1800
12—	10	Reliance New b.b.	AW-324	1800

A. C. MOTORS—SYNCHRONOUS

HP	Mfr.	Type	Volts	Speed
600	Gen.Elec.(2)	TS	2200	514
400	Gen.Elec. .8PF	TS	220/440	1200
300	Gen.Elec.	ATI	220/440	720
300	Whse.	G	2300/440	600
300	El.Machy.	late	220/440	514
225	El.Machy.		220/440	480
220	G.E. 3 brg .8PF	ATI	220/440	600
200	G.E. .8PF	ATI	220/440	900
150	Gen.Elec.	ATI	220/440	300
150	Gen.Elec.(2)	ATI	220/440	720
100	American b.b.	YGH	220/440	900

- EXPLOSION PROOF MOTORS — New & Rebuilt, all sizes.
- GEARHEAD MOTORS, AC & DC.
- FREQUENCY CHANGERS.
- CIRCUIT BREAKERS, AC & DC.

A. C. MOTORS—SQUIRREL CAGE

3 Phase 60 Cycle 220 or 440 Volts

Qu.	H.P.	Mfr.	Type	Speed
1—	400	Whse. 2200V.	CS	1800
1—	300	Whse.	CS	1200
1—	250	Gen.Elec.	FT549A	3600
1—	250	Gen.Elec.	FT549	3600
1—	250	Whse.	CS954A	720
1—	200	Whse. b.b. NEW	CS875	1800
1—	200	Allis Ch.	AN	1200
1—	150	Gen.Elec. TEFC b.b.	K6333S	1200
2—	150	Howell b.b.	M584	1800
1—	150	Gen.Elec.	I-K-16	600
1—	150	Reliance b.b. NEW	B6085	1200
2—	150	Gen.Elec.	KF557	1200
1—	150	Gen.Elec.TEFC b.b.	K6335	720
2—	125	Gen.Elec.	K6058	1800
1—	125	Reliance b.b. NEW	C5085	1200
2—	125	Allis Ch. 2200V.	AN	1200
1—	125	Gen.Elec.	I-K-16	450
1—	125	Cont. 2200V. b.b.	SC	1800
1—	125	Gen.Elec.	KT379	3600
2—	125	Rel. TEFC NEW	B6085	1800
1—	100	Gen.Elec.	I-K-14	900
5—	100	Allis Ch. 2200V.	AR226	1200
1—	100	Reliance b.b. NEW	C5085	900
1—	100	Rel. TEFC NEW	C5085	1200
1—	100	Gen.Elec. b.b. NEW	K5045	1800
1—	100	Cont. TEFC	NP683	1200
1—	100	Gen.Elec.	I-K-J	720
2—	75	Gen.Elec.	I-K	900
1—	75	Gen.Elec.	I-K-14	720
1—	75	Reliance b.b. NEW	C5084	900
1—	75	Reliance TEFC NEW	C5084	1200
1—	75	Reliance b.b. NEW	C505	1800
1—	75	Gen.Elec.	KT329Y	3600
2—	75	Reliance b.b. NEW	C506	1200
1—	60	Gen.Elec.	KT583	720
2—	60	Reliance b.b. NEW	B504	1800
2—	60	Reliance TEFC NEW	C505	1200
1—	60	Reliance b.b. NEW	C504	1200
2—	60	Whse.H.T	C8504	1800
1—	60	Wagner b.b.	RP444	3600
1—	50	Allis Ch. b.b.	ARX445	1800
1—	50	Whse. b.b. NEW	C84056	1800
2—	50	G.E. NEW b.b. HT	KG405	1800
2—	50	Reliance b.b. NEW	C445	1200
2—	50	Gen.Elec.	KT336	1200
1—	50	Gen.Elec.	KT342	900
1—	50	Whse. hship	WL607	900
1—	50	Whse. b.b.	C8504	1200
2—	50	Gen.Elec.	KT352	600
2—	40	Gen.Elec. b.b.	KP504	900
1—	40	Gen.Elec. b.b.	KP4045	3600
2—	40	Gen.Elec.	KT527	1800
1—	40	ALCh. 3 speed	ARX	900/600/450
4—	40	Gen.Elec.	KT336	900
2—	40	Reliance b.b. NEW	C404	1800
2—	40	Reliance TEFC NEW	C445	1200
3—	40	Gen.Elec.	KT342	1200
3—	30	Gen.Elec.	KT342	600
2—	30	Gen.Elec.	KT332	900
1—	30	ALCh. TEFC b.b.	ARZ445	900
2—	30	Howell b.b. 4 speed	SC	1800
2—	30	Gen.Elec. NEW hiteq.	KG345	1800
2—	30	Gen.Elec. TEFC b.b.	K404	1800
1—	30	Gen.Elec.	KT336	720
2—	30	Reliance b.b. NEW	C405	1200
2—	30	Reliance TEFC NEW	C444	1200
2—	25	Reliance TEFC NEW	C444	900
3—	25	Reliance b.b. NEW	C364	1800
2—	25	Reliance TEFC NEW	B365	1800
2—	25	Reliance b.b. NEW	C404	1200
2—	25	Reliance TEFC NEW	C405	1200
3—	25	Whse. NEW spl. b.b.	C8365	1800
3—	25	Whse.	C5044	900

ARTHUR WAGNER COMPANY

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TRANSFORMERS — 60 Cycle

QU.	KVA	MAKE	TYPE	PH.	VOLTAGES
1	5000	American	LT	3	27000/2300
2	4500	GE	HT	3	27000/2300
1	1500	GE	HTI	3	4150/2300
1	1000	GE	Auto	3/2	4150 x 2406
1	1000	GE	Auto	3	3810Y-2200Y
1	500	Kuhl.	OISC	1	4900 x 2300V.
3	400	GE	H	1	6900 x 2250V.
1	300	Pitts.	ODSC	1	7800 x 440V.
3	300	GE	H	1	2400 x 120/240
1	200	Whse.	Auto	3/2	4150 x 2300
1	200	Pitts.	OISC	1	4000 x 110/220
1	200	GE	Auto	3/2	4150 x 2400
1	150	GE	KS	1	2300 x 230
1	100	Pitts.		1	3750 x 110/220
3	100	Wagner	RCKV	1	240 x 120/120
3	100	Whse.	SK	1	4400 x 220/440 Tape
2	100	Newark	Dry	3/2	440 x 220
3	100	GE Pyrn.	H	1	4160 x 220/440
3	100	GE	Auto	1	4150 x 8300
1	100	Amer.	OC	1	15000 x 2300
3	75	GE	H	1	2400 x 220/440
3	75	Whse.	SK	1	2400 x 440
7	50	Whse.	SK	1	13750 x 125/250
11	50	GE	H	1	13750 x 125/216
5	50	Whse. Instr.	S	1	4160 x 120/240
3	37½	GE	H	1	2400 x 120/240
2	37½	AC Dry	AD	1	450 x 120
1	37½	Amer.	RS	1	13800 x 220/440
1	37½	GE	H	1	13800 x 220/460
1	37½	Amer.	OISCID	1	13200 x 220/440
3	27½	GE	Dry	1	440 x 230/110
12	25	Whse.	Dry	1	440 x 220/110
1	25	Maloney	Oil	1	230/460-230/110
2	25	GE	H	1	11500 x 2440/460
1	25	Maloney	Oil	1	2400 x 120/240
1	18	GE	K		17500 x 440

A.C. GENERATORS
3 Phase, 60 Cycle

QU.	KVA	MAKE	TYPE	VOLTS	SPEED
1	2500	Whse.		2300	720
1	625	GE	ATB	600	3600
1	375	AC		480	450
1	300	GE	ATB	600	600
1	200	AC		240	3600
1	200	Whse.		240	600
1	225	Whse.		550	514
1	125	GE	ATB	240	600
1	170	Whse.		2200	900
2	80	Whse.		220/440	900
3	44	Columbia		240	1200
1	31	Amer.		120/208	1200
1	18.75	Star		220/440	1800
1	12.5	Whse.		240	1200

D.C. MOTORS

QU.	HP	MAKE	TYPE	VOLTS	SPEED
1	125	GE	RC	230	1700
3	100	GE	LC	230	625
1	90	GE	CDM	230	1750
1	75/100	CW	CMC	230	800/1000
1	75	CW	WP	230	860
1	75	GE	C	230	575
1	50	GE	CD	240	660/1300
1	50	CW	CM	230	700
1	40	GE	LC	230	700/1000

D. C. MOTORS (Cont.)

QU	HP	MAKE	TYPE	VOLTS	SPEED
1	35	GE	RC	230	860
1	30	GE	CDM	230	1800/1850
1	30	GE	RC	230	1150
1	30	GE	RC	230	1100
1	30	GE	C	230	625
1	30	GE	RLC	230	400/1200
1	25	Whse.	SK	230	825
1	25	Whse.	SK	230	600
1	25	Whse.	SK	230	400/1200
1	25	CW	CMC	230	325/670
1	25	Whse .	SK	230	300/1200

OIL CIRCUIT BREAKERS

1—3000	A GE	15000V	3 pole	FK	130
1—3000	A GE	4500V	3 pole	FK	12
2—3000	A GE	600V	3 pole	K	25
1— 600	Amp Cond.	15000V	3 pole	DR	100
1— 400	Whse.	3700V	3 pole	O	221

SPECIAL

1—120 KW 150 KVA Ames Uniflow 16 x 16 220V, 3 ph, Non-Condensing.

NEW CONTROL

4—150 HP GE CR 7051 Sq. Cage Automatic 440 V, 3 ph.

MOTOR GENERATOR SETS
3 Phase, 60 Cycle

QU.	KW	MAKE	SPEED	DC	AC
1	1000	Whse.	720	275	2300/4150 Syn.
1	1000	GE	514	600	2300/4150 Syn.
1	500	GE	900	275	2300/4150 Syn.
1	400	GE	900	275	2300/4150 Syn.
1	300	GE	1200	250	2300 Syn.
2	150	GE	1200	125/250	2300 Syn.
1	150	Whse.	600	125	4150 Syn.
1	125	CW	1200	125	2300 SC
1	100	CW	1200	125	220/440 SC
1	100	EL Mach.	1200	125	4150 Syn.
2	75	GE	1200	125	220/440 SC
6	75	GE	1200	80	220/440 SC
1	50	Ridgeway	1200	550	220/440 SC
1	50	Whse.	900	250	220/440 SC
2	40	EL Mach.	1750	125	440 SC
1	35	Ideal	1200	125	220/440 SC

A.C. MOTORS
3 Phase, 60 Cycle
Synchronous

QU.	HP	MAKE	TYPE	VOLTS	SPEED
4	200/100	Whse.		4150	720/360
1	200	EL Mach.		2300	360
1	200	GE	TS	440	257
1	185	GE	ATI	2300	720
1	150	GE	TS	220	1800
2	150	AC		2300	360
1	100	GE	ATI	2200	900
1	70	EL Mach.		2300	180
1	35	GE	ATI	2200	1200
1	20	Whse.		220	1800

SLIP RING

1	2500	GE	MT	6600	257
1	500	GE	MT	2300	720
1	300	Whse.	CW	440	600
1	150	GE	IM	440	450
1	100	GE	IM	440	400
1	75	GE	MT	220	1200 Vert.
1	75	GE	MT	440	900
1	60	GE	MT	220	1750
1	60	GE	MT	440	900
1	50	GE	MT	220	1720
1	50	GE	MT	220	1200
1	50	Whse.	CW	220	900
1	50	GE	MT	220	1700
1	50	GE	MT	220	600
1	40	GE	MT	220	1200
1	40	GE	MT	2200	1200
1	40	GE	MT	220	900
1	40	GE	MT	2200	900
1	30	GE	M	220/440	1200

SQUIRREL CAGE

QU.	HP	MAKE	TYPE	VOLTS	SPEED
1	150	CW		2200	1200
1	125	GE	KF	2300	1800
1	125	US		440	1200 Vert
1	100	LA	RY	440	1800
1	100	Whse.	CS	440	1800
1	75	GE	KF	220/440	1200
1	75	Ideal	AT	220/440	1200
1	60	Whse.	CS	2200	900 Vert
1	40	GE	KT	220	1200
1	40	Whse.	CS	220	900
1	40/20	Whse.	CS	440	575/435
1	35	Whse.	CS	2200	1200
1	35	GE	IK	550	600
1	30	GE	KT	220	600
1	25	GE	KT	220	1165
1	25	GE	KT	440	1200

LARGE STOCK OF D.C. MOTORS AND GENERATORS, SWITCHBOARD AND CONTROL EQUIPMENT

JLHCo

This Seal is your Guarantee

J. L. HEMPHILL & CO.

1604 53rd STREET, NORTH BERGEN, N. J.

PHONE NEW YORK — LONGACRE 5-3227

PHONE NEW JERSEY — UNION 3-2600

Reliably Rebuilt Electrical Equipment

41st YEAR

APRIL SPECIALS

2—600 H.P. Allis-Chalmers synchronous motors, 1200 R.P.M., 3 ph., 60 cy., 2200v. with control.

1—500 H.P. General Electric slip ring motor, 1200 R.P.M., 3 ph., 60 cy., 2200v. with control.

Rebuilt — 1 YEAR GUARANTEE

PARTIAL LISTINGS ONLY

MOTORS
Squirrel Cage 3 Phase

H.P.	Make	Type	Speed
500	West. (2)	CS	1160
450	G.E.(vert.)	KF-6338	1180
300	G.E.	IK	900
250	G.E.	FT	3560
200	Wagner	RP2	1750
200	G.E.	KF-6335	880
150	West. (2)	CS	1750
150	West.	CS	580
125	Al.Ch. (2)	AR	435
100	Wagner New	XP	1150
100	G.E.	K-544	1175
100	West.	CS	870
100	G.E. (2)	IK	575
75	West.	CS	1750
75	G.E. (3)	K-505	1178
75	G.E.	IK	900
75	G.E. (3)	KT-352	865
75	West.	CS	720
75	G.E.	K-356	690
75	G.E.	KT-558	580
60	F-M	Tot. Enc.	1800
60	West. (2)	CS-607	880
60	Rel. (2)	AA	875
60	G.E.	KT-346	865
60	G.E.	FTR-523	3600
50	Elliott	196	3450
50	West.	CS	1740
50	L.A. (3)	XP	1150
50	West.	XP	1150
50	G.E.	KF-445	1170
50	West.	CS-642C	1160
50	West. (3)	CS	870
50	G.E. (2)	IK	870
50	G.E.	FTR-542	870
50	West.	CS	690

MOTORS
Slip Ring 3 Phase

H.P.	Make	Type	Speed
600	Cr.Wh.	131AQ	507
500	G.E.	IM	1200
500	GE(2)	IM	450
400	West.	CW	514
225	Wagner	25 cy.	710
200	G.E.	MTP-557	1800
200	G.E. (2)	IM	1170
150	Wagner	31VRN	900
150	G.E.	MT-564Y	580
100	G.E.	MT-553	1165
100	Al.Ch.		690
75	West.	CW	1150
75	G.E.		690
50	West.	HF	850
50	Al.Ch.		690
50	G.E.	MT-536	1150
50	West.	CW	1150
50	G.E.	MT-336	1150
50	L.A.	OGH	870
50	F-M	BV	600
50	Al.Ch.	ARY	575
50	G.E.	IM	490

MOTORS
Synchronous

H.P	Make	Type	Speed
600	Al-Ch (2)		12n
475	West.		720
400	G.E. (2)	TS-928S	600
300	G.E.	ATI	900
260	G.E.	TS	900
200	G.E. (2	25 cy.	500
200	Ideal	SMW	257
180	G.E.	ATI	900
160	G.E.	TS	1200
145	G.E.	ATI	720
135	West.	G	1200
135	Ideal		1200
100	G.E.	TS	1200
55	El.Mchy.	BRKT	1200

MOTORS
550V. D.C.

H.P.	Make	Type	Speed
765	G.E. (6)	MPC	1045/1350

MOTORS
230V. D.C.

H.P.	Make	Type	Speed
400	A-C		415
135	C-W	CCM152H	233/900
125	G.E.	RC-15	1750
100	G.E.	RC-14	1750
100	Al.Ch.		1150
90/45	G.E.	RF-	950/475
75	Sprague		1000/1500
75	West. (2)	SK-180	475
75	Cr.Wh.	LT	480/670
75	Cr.Wh.	CMC	375/950
75	West.(3)	SK151	250/1000
60	West. (3)	SK-160	680
50	G.E.	RC-12	1750
50	Diehl		850/1050
45/90	G.E.	RF-17	475/1950
50	West. (3)	SK-160	565
50	G.E.	RF-17	250/1000
50	West.	SK	250/1000
40	West.	SK-103	1750
40	Century	DN-454	1740
40	G.E.	RC-31	1700
40	G.E.	RC-32	1100
40	G.E.	RC-34	750
40	G.E. (2)	CD-1441	400/1500
40	Cr.Wh.	CCM	700
40	Rel.	461T	400/1200
35	West.	SK-120	1150
35	G.E.	RLC	440/800
30	G.E. (8)	CDM-85	2200
30	West.	SK	975
30	Cont.	D-103	850
30	G.E.	RC-33	775
30	West.	SA	500/1500
30	West. (2)	SK-143	575
25	G.E.	RC-15	1750
25	West.	SK-83	1750
25	G.E.	*CDM-77	1750
25	E.D.	108	1500
25	Rel.	92T	1150
25	West.	SA	500/1800
25	West. (2)	SK-130	600
25	G.E.	RF-14	300/1200

MOTORS
115V. D.C.

H.P.	Make	Type	Speed
300	West.	SK	900
100	Cr.Wh.	CMC	900
40	G.E.	CD-113	850
30	West.	S	600
25	G.E. (2)	CD	1800
25	West.	SK-103	1150
25	Cr.Wh.	CCM	750
25	West.	SA	600/1200
15	E.D.	7½S	650/1230
15	Cr.Wh.	CM	650
12½	G.E. (3)	CDM-85	930/1160
12½	G.E.	*CDM-95	930/1160
10	Century	DN-334	1750
10	G.E. (2)	RC	1200
10	Al.Ch.		900
10	E.D.	7½S	425/1750
10	Diehl		230

GENERATORS — A.C.
Driven by D.C. Motors

KVA	Make	D.C. Input	A.C. Output
288	West	115	450
75	G.E.	230	240
50	Star	115	120
35	G.E.	230	220
31	Ideal	115	440
31	El.Mchy.	230	440
18	G.E.	230	120/240
10	Burke	115	120
7½	Hertner	115	440
5	El.Spec.	115	110
1¼	Al.Ch.	230	110

GENERATORS — A.C.

KW	Make	Type	Speed
216	West.	G	900
180	G.E.	ATB	900
100	G.E.	ATB	360
75	G.E. (2)	ATB	1200
50	F-M	GG	1200
15	G.E.	A8I	1200

Frequency Changers and Generators

Size	Make	Output Frequency
150 KW	G.E.	150 cy.
154 KVA	G.E.	150 cy.
50 KW	G.E.	120 cy.
40 KW	G.E.	100 cy.
30 KW	G.E.	90 cy.
15 KW	G.E.	408 cy.
10 KW	G.E.	200/700 cy.
7½ KW	G.E.	408 cy.
3 KW	G.E.	408 cy.

GENERATORS
600V. M D.C.

KW	Make	Speed
400	G.E. (4)	1200
200	Cr. Wh.	900
200	West.	1150
150	West.	1150
60	G.E.	1200
30	Burke	1750

GENERATORS
250V. D.C. Motor Driven

KW	Make	Speed
1000	G.E.	900
500	West.	1100
300	Elliott	1200
300	G.E.	1200
300	Al. Ch.	1200
200	G.E.	1200
150	West.	900
100	Delco	1200
75	G.E.	1200
50	G.E.	1200
40	Rel. (4)	1750
42	ABC (2)	1200
30	G.E.	1200
25	G.E.	1200

GENERATORS
125V. D.C. Motor Driven

KW	Make	Speed
250	G.E.	720
150	Cr. Wh.	1200
150	West.	1150
100	West. (2)	900
100	G.E.	1200
100	El. Mchy	1200
75	Cr. Wh.	1200
75	Hertner	1150
50	West.	1150
50	Cr. Wh.	1150
50	Sturt.	2800
35	Ideal	1200
30	G.E.	1150
30	L.A.	1450
25	El. Mchy. (2)	1150

GENERATORS
Low Voltage D.C.

Amp.	Make	Voltage
4000	Chandy.	6/12
5000	Optimus	6/12
1500	H-V-W	6/12
125	Hobart (8)	7½
1000	G.E.	15
750	Master	20
1500	Century	24
3000	El. Prod.	24
550	Col.	27
100	G.E.	30
1000	G.E.	33
150	Watton	40
200	G.E.	42
1500	G.E.	50
1500	Century	60
1500	G.E.	60
1000	G.E.	75

TRANSFORMERS

4—333 KVA Moloney, 2300/4600V. Primary, 230/460V. secondary.
1—300 KVA, Al. Ch. 3 ph, 41600V. Primary, 230V. Secondary.
1—300 KVA, Pittsburgh, 3 ph, 1—300 KVA, Pittsburgh, 3 ph, 41600 V. Primary, 230V. Secondary.
8—100 KVA West. 3 ph. 440-220 Dry.
2—50 KVA G.E.—H—KF, 2400/4160Y—120/240V. Sec.
4—25 KVA West. 440V. Primary, 110/220V. Sec.
3—15 KVA West. 440V. Primary, 110/220V. Sec.
60—Additional Oil and Insulated Dry-type Transformers in stock, not listed, down to 1 KVA.

STARTERS — A.C.

1—450 H.P. West. magnetic reduced voltage (550V.) Synch.
2—400 H.P. C-H Bulletin No. 9876, 440V. magnetic reduced voltage Synch.
1—250 H.P. C-H Bulletin No. 9589, 4150V.
1—200 H.P. G.E. CR-7065, 440V. Synch.
3—150 H.P. G.E. CR-7061, 220V. Synch.
2—100 H.P. C-H full voltage Synch.
40—C-H and A-B, 2 and 4 speed magnetic starters.
635—7½ H.P. C-H 440V. magnetic starters.

STARTERS — D.C.

1—600 H.P. 230V. West. magnetic.
150—New 230V. D.C. magnetic starters, from 5 H.P. to 75 H.P., C-H, G.E., etc.
100—New 230V. D.C. manual starters from 1 H.P. to 5 H.P.—G.E. and C-H.
40—New 7½ H.P. 230V. magnetic reversing.
1—300 H.P. West. 115V. magnetic.
Over 250 additional D.C. starters in stock, not listed, all sizes and voltages.

EST. 1910 L. J. LAND INC. 40th YEAR
156 GRAND STREET Phone CAnal 6-6976 NEW YORK 13, N. Y.

ELECTRICAL EQUIPMENT — REBUILT and GUARANTEED

MOTORS—GENERATORS—MG SETS—TRANSFORMERS—CONTROLS

PROMPT SHIPMENT — PARTIAL LISTING

VARIABLE VOLTAGE DRIVES

40 HP Reliance Variable Voltage Drives, each Consisting of:
1—40 KW 230 Volt, Induction M-G Set, with two auxiliary 5 KW generators and exciter.
1—40 HP 400/1500 RPM, Frame 385T, 230 Volt, DC Motor.
With full magnetic control providing log forward, log reverse, run, fast, slow, and stop, and motor operated field rheostat.

SLIP RING MOTORS—3 Ph., 60 Cy.

Qn.	H.P.	Speed	Volts	Make	Type
6	7½	810	550	G.E.	MTG-5391
3	10	1140	440	West.	HF-7A
2	10	570	220	G.E.	HI-11
2	11‡	870	550	G.E.	IPG-5068
2	15	1160	440	West.	CW-464C
2	15	570	220	West.	CW-646
1	18	880	440	West.	MW-316
1	20	580	440	West.	CW-638
1	25	1130	550	G.E.	MT-323
2	25	850	220	Wagner	BR
2	25	720	440	Wagner	22VBR
1	30	865	440	West.	CW-446
1	30	850	440	G.E.	MT-332
1	30	575	440	G.E.	MT-336
3	35	880	440	F-M	HV-H16A
3	40	885	2200	Al-Ch.	ART-325C
1	40	1140	440	G.E.	MT-346
3	50	1150	440	G.E.	M-536
1	50	880	440	West.	HF-12A
1	50	575	440	G.E.	MT-353
5	53‡	550	220	G.E.	IQC-5013***
1	60	685	440	West.	CW-756
1	60	570	550	G.E.	MTG-5844
1	60	345	550	West.	CW-938
1	80‡	575	440	G.E.	MTG-5382
3	125	420	440	G.E.	IL-16
3	150	1750	440	G.E.	MTP-549
1	175	585	550	West.	CW-1093
2	200	600	550	G.E.	IM-17
2	200	485	2200	G.E.	IM-17A
3	300	900	550	G.E.	IM-17
2	300	600	2200	G.E.	IM-17A
4	350	1775	2200	G.E.	IM-E15A
2	350	885	2200	G.E.	IM-17A
1	400	1005	550	West.	CW
1	600	1770	440	G.E.	IM-E15C
1	650**	360	440	G.E.	MT-443Y
1	700	725	4000‡‡	West.	CW

220 volt motors can be reconnected for 440 volts.
‡ Intermittent rating. *** 2 phase.
** New. ‡‡ 25 Cycle.

A.C. GENERATORS — NEW

3 Phase, 60 Cycle, 0.8 P.F., Two Bearing, with Damper Winding and Direct Connected Exciter.

Quan.	KVA	RPM	Make	Volts
4	18.7	1800	Columbia	240/120
5	18.7	1800	Columbia	208/120

230 VOLT CONST. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
10	3	850	Reliance	Y-23T
25	3½	850	West.	SK-30
1	7½	1150	G.E.	CDM-65
3	7½	850	G.E.	CD-75
10	10*	1750	Kimble	BA-334
5	10**	1150	EB-80	
2	10	850	West.	SK-83
10	13½**	900	West.	SK-93
3	15	1750	G.E.	CD-75
1	15	825	West.	SK-90
1	20	1750	L.A.	ONA-L851
1	20	1750/1310	West.	SK-83
1	20	1150	G.E.	RC-50
11	20	750	West.	SK-110L
17	25	825	West.	SK-120
1	30	1100	G.E.	RC-12
1	40	1750	West.	SK-103
1	40	750	G.E.	RC-84
1	50	750	West.	SK-150
1	50	650	G.E.	RC-16
1	60	1750/1310	West.	SK-143
1	150	700	Al.-Ch.	
2	200	1150	G.E.	RC-88
1	250	1150	C.W.	CMC-101A

230 VOLT ADJ. SPEED D. C. MOTORS

Qn.	H.P.	Speed	Make	Type
6	5/7½	600/1800	G.E.	RA-30
1	10	400/1600	Reliance	T-92T
1	10/15	800/2400	Reliance	T-92T
1	13½	900/849	West.	SK-130
10	13½**	900	West.	SK-93
1	15	600/1200	West.	SK-100L
1	20	500/1500	G.E.	RP-11
1	20/25	400/1600	Reliance	T-32-T
1	20/25	300/1500	West.	SK-153
1	25	400/1600	G.E.	RP-13
1	25	500/1500	G.E.	RP-15
1	25/29	500/1500	G.E.	RP-13
1	30	400/1200	West.	SK-163
1	30/40**	400/1600	G.E.	CD-1224
1	30	500/1500	West.	SK-143
1	40/50	400/1200	Reliance	T-4611
1	75	500/1500	Cr.-Wh.	CCM
1	75	375/750	Cr.-Wh.	CMC-125H
8	100	225/900	G.E.	MPC-A
5	100	400/1200	Al.-Ch.	
1	100	320/960	West.	SK-200
1	125	450/1000	West.	SK-190
1	175	250/500	West.	SK-220
1	275	350/500	G.E.	MPC

**New.

SQUIRREL CAGE MOTORS—3 Ph., 60 Cy.
Totally Enclosed Fan Cooled, Ball Bearing

Qn.	H.P.	R.P.M.	Volts	Make	Type
1	5	3480	220	G.E.	K-225
2	5	1750	440	L.A.	JA-254
10	5	1730	440	G.E.	K-254
2	5	1165	440	L.A.	JA-284
5	7.5	1740	440	G.E.	K-284
1	10	3480	440	West.	CS-324
1	10	1140	440	Wagner	CP2-326
1	10**	880	220	West.	CS-365-EXPP
1	15	1745	440	West.	CS-326
1	15	1175	440	L.A.	JA-365
1	20	1760	220	G.E.	K-364
1	25	1760	220	G.E.	K-365
1	25	1200	550	G.E.	K-405
1	25	1170	220	L.A.	JX-405
1	25	705	440	West.	CS-W504
1	40	3565	440	G.E.	KF-4058

Splashproof, Ball Bearing

Qn.	H.P.	R.P.M.	Volts	Make	Type
22	5	1750	440	L.A.	FS-254
1	5	1735	220	G.E.	K-254
1	5	1160	440	L.A.	FX-284
1	10	3480	440	G.E.	K-284
1	15	1175	440	L.A.	JA-285
4	15	1150	440	L.A.	FX-365
2	40	1175	220	G.E.	K-445
3	50	1760	440	L.A.	FX-445A
5	50	1160	220	G.E.	K-504
1	125	1770	440	L.A.	FX-1078Y
1	150	1775	440	L.A.	FX-1168
5	150	880	440	L.A.	FX-1368
1	150	709	440	G.E.	KF-6335
1	200	885	440	L.A.	FS-1378

Open Type Motors

Qn.	H.P.	Speed	Volts	Make	Type
1	15	3485	220	Reliance	AA-B3347
5	15**	1735	440	Century	SC256
1	15	1200	220	G.E.	KT-562
1	15	900	220	G.E.	FTR-512
1	20**	3475	220	West.	CS-326
5	20**	1750	440	Wagner	RPI-364
1	20	1750	220	West.	CS-W364
1	20	1200	220	G.E.	KF-512
2	20	1160	440	West.	CS-464C
2	20	900	220	G.E.	FTR-532
1	25	1800	220	G.E.	KT-512
5	25**	1740	440	Century	SC-364
1	25	1160	440	West.	CS-667C
1	25	900	220	Howell	SCRB-356***
2	25**	875	440	Master	PB-405
2	25	575	440	G.E.	KT-542
2	30	3550	550	G.E.	K-364B
1	30	1160	440	West.	CS-644
1	30	870	220	West.	CS-646
1	40**	3565	220	G.E.	KF-4045
2	40	1750	440	West.	CS-583C
2	40	900	2300	G.E.	FTR-536
4	50**	1750	440	Wagner	RP5-405
1	50	850	220	West.	CCL
2	60**	1750	440	Ideal	AH-444
2	60	900	440	G.E.	KT-546
1	75	1160	440	West.	CS-662C
1	75	870	220	West.	CS-768A
2	75	1765	2300	G.E.	KT-552
1	100	600	220	West.	C
1	100	580	2200	G.E.	IK-15A
2	100	900	2200	West.	CS-930
1	100	495	2300	Al.-Ch.	AN
2	125	435	440	Al.-Ch.	AN
2	125	440	2300	G.E.	I-17-FH
1	200	580	550‡‡	G.E.	KT-584B
2	300	587	2200	West.	CS-39A
1	400	1165	2200	G.E.	IK-E15B
1	500	1200	440	G.E.	KTP-587
1	700	1800	2300/4000	West.	CS-4-39D-12

220 volt motors can be reconnected for 440 volts.
** New. *** 2 Phase. ‡‡ Reconnectable for 440 volts.

G. E. DYNAMOMETERS

Cradle Type, with Control and Dial Scale
(Write for Complete Specifications)

Qn.	HP	D.C. Volts	RPM	Type
1	50/75	250	1650/4000	TLC-30
2	100	250	1050/3600	TLC-50
1	200	250	1200	C

MOTOR GENERATOR SETS
125 and 250 Volts D. C.
(Write for complete Specifications)

KW	Make	RPM	D.C. Volts	A.C. Volts
2	Cont.	1750	125	220/440
7.5**	West.	1455	125	380/220‡
10	West.	1750	125	220/440
10	West.	1450	125	220/440†
10	West.	1150	250	220/440
15**	G.E.	1800	125	220/440
15	G.E.	1755	250	220/440
15	West.	1450	125	220/440‡
15	West.	1750	125	2200/440
20	West.	1750	250	220/440
25	G.E.	1800	250	220/440
25	G.E.	1200	125	220/440
30	G.E.	1800	250	220/440
30	Al-Ch	1750	125	220/440
50	West.	1750	250	220/440
50	G.E.	750	125	220/440†
75	G.E.*	1200	125	220/440
75	G.E.	1200	250	2300/440
100	Columbia*	1200	250	2300/440
150	West.*	1200	250	2300/440

Note: 3KW, 5KW & 7.5 KW, 250 V. Sets Avail.
** New * Synch. Motor Driven. § 50 Cy. † 25 Cy.

Above Items Represent a Partial Listing Only. Your Inquiries Will Receive Our Prompt Attention. All Equipment is Located in Our Cleveland Warehouse. We Have Controls for Most Items Listed.

ELECTRIC GENERATOR & MOTOR CO.
4521 HAMILTON AVE. CLEVELAND 14, OHIO

DIESEL GENERATOR SET!

225 HP Busch Sulzer Model DF, 3 cyl., 4 cycle, solid injection, 360 RPM. Direct erator with direct connected exciter, air connected 150 KW 3/60/2300 volt genfilter, muffler, etc. A modern unit in perfect condition only $4000 f.o.b. St. Louis.

MISSISSIPPI VALLEY EQUIPMENT CO.
507 Locust St. St. Louis 1, Mo.

FREQUENCY CHANGERS

—250 KVA Fairbanks-Morse 360 cycle/sync. motor drive.
—100 KW Elec. Prod. Co., 180 cycle/sync. motor drive.
— 25 KW Gen. Elec., 240 cycle/squirrel cage motor drive.

Generating equipment of every description available. Your inquiry will get prompt attention.

Telephone: MAin 4-5900
EMPIRE ELECTRIC COMPANY, INC.
87-93 Jay St. • Brooklyn 1, N. Y.

Vertical Hydro-electric Units

1—500 K.V.A. 3 ph. 60 cy. 2400 v. 200 R.P.M. complete for 77 to 30' hd.
1—250 K.V.A. 3-60-2400 V 150 RPM for 12'-15' hd.
1—225 KW 3 ph. 60 cy. 2300 v. 180 RPM for 18-22' head
1—312 K.V.A. 3 ph. 60 cy 2400 v. 1800 RPM for 17-20' hd.
1—144 KW 3 ph. 60 cy. 550 v. 120 RPM for 9-13' head
1— 80 KW 3 ph. 60 cy. 2300 v. 300 RPM for 12-22' head.
1—1500 KW Vert. unit complete for 50' hd.
2—600 KW units horiz. for 50' hd.

Several horizontal units in good condition priced to sell. All subject to prior sale. We are headquarters for good hydroelectric units. For full particulars wite

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WATERTUBE BOILERS

IMMEDIATE DELIVERY

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250# PSI 160# PSI

for SPREADER STOKER or OIL FIRING

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P.O. Box 1478, Rochester, New York

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150 HP FYNN WEICHSEL SYNCHRONOUS MOTOR

900 RPM, 3 phase, 440 Volts 60 cycles. Complete with control equipment.

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- for every industrial and power application
- Special constructions. Odd lengths.
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- Cut to length. Reasonably priced.

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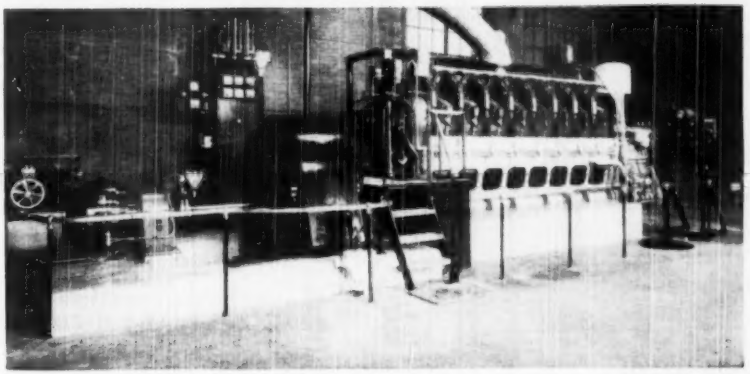
DIESEL POWER



DIESEL POWER

Last year the Public Utilities Commission of Brockville, Ontario, was experiencing a serious shortage of power and it became mandatory that a dependable source of power be added immediately. The Commission approached "AGSCO" and purchased the 1000 KW Remanufactured GMC Diesel Unit which is pictured above. This unit was shipped, installed and "on the line" in 58 days, a record of which to be proud.

Other power users in this region were also short of power and large "AGSCO Remanufactured Diesels" were installed for Kellogg Co. at London, Ont.; York Knitting Mills, Toronto, Ont.; Canadian Steamship at Montreal, Ont.; Utilities Commission of Woodstock, Ont. and City of Orillia, Ont.

Select dependable AGSCO Remanufactured Diesels for your power requirements today.

Save on Initial Acquisition Costs with "AGSCO REMANUFACTURED DIESEL EQUIPMENT"

UNITS AVAILABLE FOR IMMEDIATE SHIPMENT

KVA	MAKE	MODEL	HP	RPM	KVA	MAKE	MODEL	HP	RPM
1875	Fairbanks Morse	33F16	2000	300	312.5	Faribanks Morse	33D	375	360
1420	Fairbanks Morse	38D	1600	720	312.5	General Motors	8-268A	450	1200
1250	General Motors	16-278A	1600	720	312.5	Clark	MD-4	375	327
1250	Nelseco	6M1-53	1500	300	300	Fairbanks Morse	YVA	360	257
1000	General Motors	12-278A	1200	720	250	General Motors	8-268A	350	1200
937.5	General Motors	12-567	1080	720	200	Buckeye	80	240	600
625	Superior	OS	750	327	156	Buckeye	E	190	400
625	Alco	6-12-½x13T	750	600	125	General Motors	3-268A	150	1200
425	Baldwin	VO	510	450	121	Fairbanks Morse	32E14	140	300
400	Buckeye	80	480	600	75	General Motors	6-71	90	1200
375	Enterprise	DSG-6	450	450	62.5	Int'l Harvester	UD-18	76	1200
330	Superior	KNA	396	514	50	General Motors	4-71	60	1200

"SPECIALISTS IN DIESEL POWER"

Engineered AGSCO DIESEL POWER

A. G. SCHOONMAKER Company, Inc.

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FROM AVAILABLE STOCK

Rebuilt to N.I.S.A. Standards

MOTOR GENERATOR SETS

3 ph. 60 cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1	1000	G.E.	600	125/250	4000
1	1500	G.E.	600	600	2300/4150
1	1500	G.E.	360	275	2300/4400
1	1350	G.E.	600	275	2300
1	1000	G.E.	720	250	2300/13200
1	1000	Whse	900	600	2300/4150
1	1000	Whse.	514	250	4150
1	980	G.E.(3U)	1200	120/240	2300
1	750	Whse	900	250	2300
1	500	G.E.	720	600	2300/4150
1	500	G.E.	720	125	2300/4000
2	400	G.E.	720	250	440/2300
1	400	G.E.	1760	120/240	440
1	350	G.E.	900	125	2300/4150
1	300	G.E.	1200	250	440
1	150	Cr. Wh.	1200	250	440
1	140(3U)	Cr. Wh.	600	125/250	2300
1	100	G.E.	1170	125	220
1	75	Cr. Wh.	1170	250	220/440
1	75	Cr. Wh.	1360	250	550

ROTARY CONVERTERS

60 Cycle

Qu.	KW	Make	Speed	D.C. Volts	A.C. Volts
1—2000		G.E.	514	600	13800
1—2000		G.E.	450	600	2300
1—1000		Whse.	900	600	11000
1—750		Whse.	900	600	13200

RECTIFIERS

1—750	G.E.	BHW	575	2300
1—1000	A.C.	B-612	625	13500
1—1000*	A.B.B.	GRZ	625	6600/13200

*This unit with full automatic control good for both 25 and 60 cycle.

TURBO GENERATORS

Qu.	KW	Make	Does
1	4000	G.E.	Auto Extraction 250# ISP 15# Ext. 2400V. 3 ph. 60 cy.
1	2000	G.E.	Condensing. 175# ISP—4600V. 3 ph. 60 cy
1	1000	G.E.	Condensing 135/150# ISP 2300/4150 V 3 ph. 60 cy.
1	750	G.E.	Condensing 350/375# ISP 440V. 3 ph. 60 cy. (New 1944)
2	400	G.E.	Condensing. 375# ISP Geared to 1200 RPM. 120/240V. D.C. Generator.
1	300	G.E.	Non-condensing 150/175# ISP 9/15# B.P. 480V. 3 ph. 60 cy.
1	300	Al. Ch.	Condensing 425# ISP Geared to 1200 RPM. 120/240V D. C.
	200	Cr. Wh.	Condensing 350# ISP Geared to 1200 RPM—125V. D.C. Gen.
1	200	Whse.	Non-condensing 150# ISP 7# B.P. 240V. 3 ph. 60 cy.

TRANSFORMERS

60 Cycles

Qu.	KVA.	Make	Type	Ph.	Voltages
1	2500	Packard	AT	3	13800 x 2300
1	2500	Al. Ch.	OISC	3	13200 x 2300
2	1000	Pitts	OISC	1	13200 x 2300
3	1250	G.E.	H	1	6600 x 550
1	1050	G.E.	WCTH	3	11000 x 445
1	1000	Maloney	OISC	3	13200 x 480
1	600	Al. Ch.	OISC	3	4000/2300 x 216
3	333	Pitts	OISC	1	26400 x 2000
3	250	Al. Ch.	OISC	1	2300 x 130
3	200	Whse.	OISC	1	7200 x 240/480
3	167	G.E.	OISC	1	2400 x 240/480

D. C. MOTORS

HP	Make	Type	Volts	Speed
1—1750	Whse.		600	525/720
1—1500	Whse.		525	600
1—1200	Whse.		600	425
1—800/1000	Whse.		450	600/720
1—650	G.E.	MPC	250	115/145
1—600	Al. Ch.	MILL	230	400/800
1—300/400	G.E.	DYNA	250	1335/2500
1—335	Whse.	MG	230	300/900
1—300/300	G.E.	MPC	230	360/920
1—275	Whse.	QM-600-6	230	425/850
1—250	G.E.	MPC	230	400/500
1—230	Al. Ch.		230	700
1—150	G.E.	MPC	230	250/450
1—150	G.E.		600	250/750
10—150	Cr. Wh.	83H	230	890

FREQUENCY CHANGERS

1—2000	G.E.	25/60 Cycle	2300/2300V
1—500	A.C.	25/60 cycle	11000/2200V

A. C. MOTORS

3 ph. 60 cycle

SYNCHRONOUS

HP	Make	Type	Volts	Speed
2—3500	G.E.	TS	2300	257
1—2100	G.E.	ATI	4000	514
2—2000	Whse.		2300	120
1—1470	Whse.		4000	900
1—1000	Whse.		2300	1800
2—900	Al. Ch.	(New)	2200	150
1—650	Whse.	NG	2200	138
1—600	Whse.	Syn.	440	360
1—500	G.E.	ATI	440	900
1—500	G.E.	TS	4150	600
1—450	Whse.	Eng.	2200	138.5
2—350	G.E.	TS	2200	150
1—328	G.E.	ATI	2300	600
1—300	G.E.	ATI	440	720
1—300	Whse.		2300	720
1—300	Al. Ch.		440	600
2—125	G.E.	ATI	440	450

SLIP RING

1—1000	Whse.	CW	2300	700
2—700	Whse.	CW	2300	900
1—500	G.E.	IP	550	505
1—500	G.E.	IM-Mill	2200	450
3—450	G.E.	IM	440	506
1—400	G.E.	MT 413	440/2300	705
2—350	Whse.	CW	2200	900
1—350	G.E.	MT-442Y	2300/4000	253
1—300	Al. Ch.	T Brg.	2300	505
1—300	G.E.	IM	440	720
9—300	Al. Ch.	ANY	2200	705
1—250	G.E.	MT-434Y	4000	257
1—250	G.E.	MT-553S	2200	1750
4—100	G.E.	MT-586Y	440/2200	425
2—100	G.E.	IM-16	2200	435
2—100	G.E.	IM	440	600
3—100	Al. Ch.	AK	2200	1200

SQUIRREL CAGE

2—450	Whse.	CS	2300/4150	554
1—250	G.E.	KT-589	440	806
1—200	G.E.	IK	550	885
1—200	G.E.	KT-557	440	1800
1—200/113	G.E.	KF-589BB	440	1170/885
1—125	Whse.	MS	440	885
1—125	(New) G.E.	KF-TEFC	440	1180
1—125	G.E.	KF-TEFC	440	3585
2—100	Al. Ch.	AR	2200	1170
1—100	G.E.	IK-Vert.	2300	450
2—100	G.E.	KT-543	220/440	1750

SYNCHRONOUS CONDENSERS

Qu.	Kvs.	Make	Type	Volts	Speed
1	5140	Whse.		4150	600
1	4000	G.E.	TSC	2400/4800	900
1	3000	Whse.		4000	720

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1—Now 15,000 KW 13,800 V. 600# Cd.
2—New 4000 KW 4160 V. 600# Cd.
1—3500 KW 550 V. 200# Cd.
1—2500 KW 550 V. 250# Cd.
2—1800 KW 2300 V. 400# Cd.
2—1000 KW 2300 V. 200# Cd.
2—1000 KW 480 V. 150# Cd.
1— 750 KW 480 V. 150# NC.
1— 750 KW 240 V. 150# Cd.
1— 750 KW 550 V. 175# EX.
1— 465 HP Turbine 900#

BOILERS

2—50,000# 300#
1—30,000# 400#
1—623 HP—450#
2—500 HP—200#
1—487 HP—200#
2—250 HP—125#
2—220 HP—160#
1—72" HRT 150#

DEAERATING HEATERS

3—80,000# Pr. Hr.

ENGINE GENERATORS

1—500 KW 2300 V. Unit.
1—375 KW 2300 V. Unit.
1—168 KW 220 V. Unit.

DIESEL GENERATORS

2—400 KW—2300 V.
2—200 KW—480 V.

COMPRESSORS

33,330 CFM—Cent. 7#
4000 CFM—Gas 50#
1700 CFM—100#
500 CFM—Diesel (2)

Write or wire for additional data and prints.

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3—1000 KVA A-Ch 13800-2400
3—500 KVA G-E 2400-240/480
3—500 KVA G-E 11500-2300/4000Y
1—400 KVA G-E 13200-120/240
3—333 KVA G-E 33000-2300/4000Y
3—333 KVA G-E 13800-120/240
3—333 KVA G-E 13800-230/460
3—333 KVA G-E 11000-2300/4000Y
3—333 KVA G-E 2400/4160Y-240/480
1—250 KVA G-E 6900/11950Y-230/460
3—200 KVA G-E 6900/11950Y-230/460
3—200 KVA G-E 6600/11430Y-2300
3—150 KVA G-E 22000-2300/4000Y
3—150 KVA G-E 11000-2300/4000Y
3—150 KVA G-E 6900-460/230
3—150 KVA L-M 2400/4160Y-120/240

Many other items in stock

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Reliable rewind and repair services on all makes of transformers

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New Chrysler Diesel Power Units, 75 HP, Model IND-3, 6 Cyl., Elec. Start, Includes Radiator, 4 Batteries, Spare Parts & Twin Disc Clutch.

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Diesel Gasoline and Steam Generators, Electrical and Industrial Equipment

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2—404 H.P. Springfield sectional, oil
1—250 H.P. Stirling, Coxe stoker
2—500 H.P. Erie City, oil
2—600 H.P. Stirling type, Spreader stoker
3—72" } Suspended HRT, band fired
3—84" }

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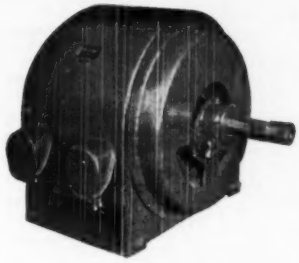
M-G SETS

KW	D.C. Volts	A.C. Volts	Mfg.
500	250	2200	C-W
400	125/250	2300	Ideal
300	250	2200	G.E.
300	125/250	440/2300	Allis (New)
200	250	2200	Whse.
200	125/250	2200	G.E.
150	250	440	G.E.
125	250	440	Whse.
100	250	220/440	Star (New)
75	250	440	C-W
60	250	220	G.E.
50	250	440	Whse.

Reconditioned and guaranteed

SYNCHRONOUS

HP	RPM	Volts	Mfg.	Type
800	150	440	G.E.	80%
650	138	2300	Whse.	Engine
600	450	2300	G.E.	80%
500	600	2300/4160	G.E.	80%
500	514	440	E-M	100%
400	900	2300	Whse.	80%
400	720	440	G.E.	80%
400	600	440	G.E.	100%
400	514	440	G.E.	100%
350	900	440	G.E.	100%
350	200	2300	Whse.	100%
300	514	440	G.E.	100%
250	600	4160	E-M	100%
150	900	4160	G.E.	80%
75	900	220	E-M	80%



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New 1250 HP 720 RPM G.E. MT 2300/3/60 Slip Ring Motor, with Hyd. Coupling and Magnetic Control.

2—New 500 HP, 1200 RPM Elliott, 220/440 V., 3 Ph., 60 Cy., Shaft 4½" dia. x 8" long. (Photo above).

NEW SLIP RING CONTROLS
12—250 HP 440/3/60 Fully Magnetic, Reversing, 7 steps acceleration, Allis-Chalmers, with air ckt. brkr. Open or enclosed.

NEW DIRECT CURRENT

230 Volt Drip proof — ball bearing

Qu.	HP	RPM	Mfg.	Frame
5	250	1750	A-C	149
1	75	400/1200	Rel.	651-T
2	30	850/1700	Rel.	230-T
3	10	1758	Rel.	34-T
1	10	575/2300	L.A.	Ball
5	7½	575/2300	G.E.	77-CD

Reconditioned and guaranteed
230 VOLTS D.C.

HP	RPM	Mfg.	Brg.
250	400/1200	E-D	Ball
200	300/900	Whse.	Ped.
200	400/1200	Rel.	Ball
150	300/1050	C-W	Ball
125	400/1200	G.E.	Slv.
125	300/900	Rel.	Slv.
100	500/1500	C-W	Ball
100	475/1350	E-D	Slv.
75	500/1500	C-W	Ball
60	400/1200	Whse.	Slv.
50	350/1050	Whse.	Ball
40	400/1600	Rel.	Ball

SLIP RING — R & G.

HP	RPM	Volts	Mfg.
700	720	2300	Allis
500	450	2300	G.E.
450	514	440	Whse.
350	900	2300	Whse.
350	450	2300	Whse.
250	900	440	Whse.
200	1200	440	G.E.
150	900	2300	C-W
125	900	440	Whse.
125	720	440	E-M
100	600	2200	A-C

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Save 40% to 60% One—Two—Four Stage

CFM	Pressure	Make	Size
40	500	IR	5/2½x4
80	100	Worth	6x5—HB
105	350	CPT	7.3½x7—T-CB
122	100	Amer.	7x7—AF-1
166	135	Amer.	8x5—AF-1
368	100	CPT & IR	12x10
368	125	CPT	12/7x10 Synch.
386	115	IR & CPT	12x12
488	110	CPT	11½/7x7 Y-CM
528	100	IR	14x12 ER-1
567	125	Worth	15.9½x12 DB-2
597	110	IR	XPV—Steam
668	50	Worth	15x11—HB
676	125	IR	15.9½x12—XCB
868	125	CPT	17/10x12—OCB
1290	1250	Worth	19/11½x11
1452	70	Penn	15/15x14 Duplex
2340	110	CPT	18/14x10—W-CE

All Makes — Many Other Sizes
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— SINCE 1902 —

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TRANSFORMERS
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NORTHERN METAL CO. — MACHINERY at REDUCED PRICES

DIESEL GENERATORS

100 K.W. Allis Chalmers. 1944. 3/60/120/450.
Exciter: 3 K.W. 120 V. D.C.
Diesel Engine: Lorimer. Model F5SS. 150 H.P. 7½"x9½".
5 cylinder, with electric starting motor.

MOTORS

Westinghouse. 1944. Synchronous—Induction.
60 Pole. 3300 S.H.P. 3 Phase. 82.5 Cycles. 2200 Volts.
165 R.P.M. Power Factor 100%.
Exciter: 125 Volts D.C. Load Factor 100%. 1944.

BOILERS

WATER TUBE. Babcock & Wilcox. 1945. 2 Drum. Bent Tube. Economisers. Internal Desuperheater. Superheaters. W.P. 400 P.S.I. Hydrostatic Press. 718 P.S.I. Heating Surfaces: 2441 sq. ft. Superheater 350 sq. ft. Economiser 1620 sq. ft. 3 Todd "Hex Press" Fuel Oil Burners. Diamond Soot Blowers. Auxiliaries available.

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ALL SIGNS POINT TO CHICAGO ELECTRIC FOR REBUILT POWER EQUIPMENT

AC MOTORS · DC MOTORS · GENERATORS · M.G. SETS · CONVERTERS · COMPRESSORS · SWITCHBOARDS · TRANSFORMERS · CONTROLS · HOISTS

SAVE 40 TO 70% IN PRICE—GET A-1 QUALITY

Here's a partial listing of our half million dollar stock

SLIP-RING MOTORS

3 phase, 60 cycle—220 or 440 volt (*2200 volt or higher)

H.P.	Make	Type	Speed
2500	*G.E.	MT	257
2000	*G.E.	MT-30	240
1250	*G.E.	M	720
1200	*G.E.	MT-26	277
800	*Westg.	CW	507
650	Westg.	HF	360
500	Westg.	CW	360
500	Westg.	CW	450
400	G.E.	IR	1800
300	*G.E.	IR15A-4	1200
300	G.E.	IM-17	1200
250	Westg.	CW-32B	900
250	Westg.	CW	600
200	G.E.	IM	600
150	Al. Ch.	ANY	600
100	G.E. NEW	No. 63332	900
100	G.E. NEW	M6334	720
100	Westg.	CW-856C	600
100	G.E.	IM-15A	450
75	G.E.	IM-E-14	1800
75	Westg.	CI-756A	600
60	*Westg.	CW-762C	900
50	G.E.	IM-11A	1800

SQUIRREL CAGE MOTORS

3 phase, 60 cycle—220 or 440 volt (*2200 volt or higher)

H.P.	Make	Type	Speed
750	G.E.	KT	720
500	G.E.	KTP-567	1200
400	*Al. Ch.	ANW	900
300	G.E.	FT-359-A	1800
250	Westg.	CS-956A	600
200	Reliance	AA-C6085S	1200
200	*G.E.	IE-15-K	600
150	Westg.	CS-771	1800
150	G.E.	IE-13AK	1800
150	G.E.	IE-13B	1200
150	G.E.	I-15-S	900
150	Westg.	CS-950-A	600
125	G.E. TEFC	K-6326S	1200
125	G.E.	KT-558	900
100	U.S.-Vert.	CPU-901-A	1200
100	G.E.	K-6333	720
75	*Al. Ch.	AR-223BS	1800
75	G.E.	FTR-543-6	1200
75	*G.E. Vert.	CR	900
75	G.E.	I-10-K	720

SYN. A. C. MOTORS

3 phase, 60 cycle—220 or 440 volt (*2300 volt or higher)

H.P.	Make	Type	P.F.	Speed
1000	*Westg.	RC-3D358	.8	900
700	*G.E.	ATI	.8	720
450	El.-Ma.		1.0	240
320	*Al.Ch.	Dr. Prf	1.0	720
250	*Al.Ch.		1.0	720
200	*Al.Ch.		1.0	360
150	G.E.	ATI	.8	600
125	G.E.	TM-954S	1.0	1200
100	Cr. Wh.	103-S	.8	900

A. C. GENERATORS

3 phase, 60 cycle—220 or 440 volt (*2300 volt or higher)

1000	*Westg.	803D	.8	900
725	*G.E.	ATI	.8	720
250	*Al.Ch.		.8	720
156	G.E.	ATI	.8	600
125	El.Ma.	PM	.8	720
112	G.E.	TS854S	.8	1200
110	*Cr.Wh.	103-S-8	.8	900
100	*G.E.	ATI-8	.8	900

TURBINE SETS

K.V.A.	Make	Press.	A.C.V.
1800	Gen. Elec.	400-C	2300
1250	Gen. Elec.	750-NC	2300
625	Al. Ch.	140-C	480
312	Moore-C. W.	425-C	480
25	DeLaval-C. W.	150-NC	240

2 COMPLETE VARI-VOLT DRIVES

M. G. Set. 200 K.W., D.C. gen., Elec. type MPC, 250 volts, 800 amps, 1200 RPM, dir. conn. to 300 HP syn. motor, Gen. Elec. type TS, 3 ph. 60 cy. 440 volt, .8 PF., 1200 RPM.

D. C. Motor, 250 HP, Gen. Elec. type MPC, 245 volts, 730/975 RPM, with complete starting and control panels.

1000 K.W., Gen. Elec., type MPC, shunt 275 volt, 3640 amp. direct connected to 1120 K.V.A. Gen. Elec. type TS, 3 ph. 60 cy. 4000 volt, 141 amp. .8 PF, 514 RPM, on fab. sub-base (250 volt fields bus excited.

ROTARY CONVERTERS

K.W.	Make	Characteristics
50	N.W.	3 ph. 220 V. to 115/230 V.D.C.
21	G.E.	230 V. D.C. to 3 ph. 120/208 A.C.
6	G.E.	230 V. D.C. to 3 ph. 220 V. A.C.
3	N.W.	240 V. 1 ph. A.C. to 110 V. D.C.
2.5	N.W.	110 V. 1 ph. A.C to 220 V. D.C.

BALANCING SETS

4—34 K.W., 250 v., 270 a. new. Rogue, type MCL 125 v. gen. BB, comp'd, d/c2on fab. base.
4—20 K.W., 250 v., 160 a. new. Cr. Wh., type 151, 125 v. gen. 3 sl. brg. Close epld.

750 K.V.A. DRY TRANSFORMERS

6—750 KVA Westinghouse air cooled Class B, wd. 12,500 V. pri. to 460 V. sec. 3 ph. 60 cy. 4—2½% taps.

MOTOR GENERATOR SETS

K.W.	Make	A.C.	D.C.
1000	G.E.	4000	275
500	G.E.	2300	230
500	G.E.	440	230
500	G.E.	4000	1200
450	G.E.	2300	255
200	Cr. Wh.	2300	120
200	G.E.	440	235
150	Al.Ch.	220	120
100	G.E.	440	250
75	Star	440	230
75	G.E.	440	250
60	Al.Ch.	2300	115
60	Ft.Morse	220	120
50	Westg.	220	110
40	Cr. Wh.	220	125
20	G.E.	440	250
20	G.E.	440	125
15	Ideal	220	125
10	Cr. Wh.	220	125

LOW VOLTAGE—M.G. SETS

Amp.	Make	A.C.	D.C.
1500	Chandyn	440	60
1500	G.E.	2300	60
1000	Chandyn.	440	40
333	Columbus	440	45

TRANSFORMERS

Q-KVA	Ph.	Make	Pri./Sec.
1—3333	1	G.E.	41600/6000
3—1500	3	Gregory	4160/480
3—1000	1	Westg.	66000/7200
2— 500	1	G.E.	2400/480
1— 333	1	Al. Ch.	13200/7200
6— 200	1	Westg.	2400/480
3— 200	1	G.E.	7200/2300
3— 150	1	G.E.	4800/480
3— 100	1	G.E.	7200/2300
3— 25	1	Al. Ch.	2400/240

D. C. MOTORS—230 V.

H.P.	Make	Type	Speed
250	G.E.	MPC-8A	730/975
150	G.E.	RC-39A	600
100	Al. Ch.	E-182	575/1150
100	Nat. Elec.	RC-34	2500
75	G.E.	RC	1500
60	Westg.	SK-133	1200
40	Roth	FB-50	600
40	G.E.	RC-34A	750
40	Al. Ch.	R-151	850
35	Cr. Wh.	CM-351	700
35	Sprague	C	600
30	Westg.	SK-120	975
30	Sprague	C-60	300
30	Cr. Wh.	CCM-50H	450
25	Westg.	SK-100L	1150
25	Al. Ch.		700
25	Westg.	S-9	500
20	Westg.	SK-83	1800
20	G.E.	RC-11-A29	1150
20	G.E.	RC12A	900
20	Cr. Wh.	CM-201	775
20	Sprague	LC	575

D. C. VARI-SPEED—230 V.

500	G.E.	MPC	160/250
325	Westg.	GM	450/900
250	G.E.	MPC	720/900
125	Reliance	1050T	600/1800
100	Al. Ch.	E-182	525/1150
60	Westg.	SK-170	525/1000
60	Nat.		250/1000
35	Sprague	C-60	300/900
30	Westg.	SA-8	500/1500
30	Westg.	SA-12	400/1200
25	G.E.	GD-103	400/1500
20	Al. Ch.	E-145	300/1200
15	Reliance	185T	400/1600
15	G.E.	CD-150	400/1600
15	G.E.	RF-11	400/1100
15	G.E.	RC-116	500/1500

GASOLINE ENG. SETS

3 ph. and 1 ph.—60 cycle

K.V.A.	Make	Model	Speed
31.2	Le Roi	E33-50	1200
25	Le Roi	E33-50	900
10	Onan	P2S5G	1800

First Source for 40 Years for Quality Electrical Equipment

CHICAGO Electric Co.

1320 W. CERMAK RD. Canal 6-2900 CHICAGO 8, ILL.

G. M. DIESEL

MODEL 6-278A

Extremely Attractive Buy

General Motors Marine Diesel, 6 cyl., 2 cycle, 600 shaft horsepower, complete with General Electric D.C. generator, 300 kw. Full accessories. Eight boxes brand new spare parts. Exhaust muffler.

This engine and generator virtually new. Used only a few hours on Navy Training School test stand. In superb condition. Attractively priced for immediate sale.

Write or wire for complete descriptive material.

PETRUS INDUSTRIAL MACHINERY SALES
1486 W. 25th St., Cleveland 13, Ohio

USED D.C. MOTORS

H.P.	Make	Type	Volts	Speed
1-1	Cr. Wh.	CM	230	1200
1-2	Cr. Wh.	—	230	1625
2-2	G.E.	K	220/440	865
1-2	—	—	220/440	1750
1-2	Cr. Wh.	SM	230	550
1-2	Cr. Wh.	CM	230	900/1200
1-3	G.E.	CQ	230	1650
1-5	West.	CCL	220	1200
1-5	Ohio	—	230	500
1-7.5	West.	SK	220	1150
1-15	G.E.	RC11	230	800

HARRIS WRECKING COMPANY
1963 W. 3rd Street, Cleveland, O.
CHerry 1-1907

TWO STOKERS, COMPLETE

Detroit Overfeed Rotostoker—double feed. Capacity: 500 boiler H.P. Grate area: 45 sq. ft. Grate dimensions: 6 ft. x 7 ft. 6 in. Stokers complete with forced draft fans. Stoker parts: 4 feed units, 2 drive units, 2 blower fans, 2 wind tunnels, 2 set grates, 2 boiler fronts for mounting feed units.

PURITY BAKERIES
97 E. 12th St. St. Paul 1, Minn.

POWER EQUIPMENT

2—3 cyl. 120 HP, 250 RPM, Winton Diesel Eng.
4—Allis Chal. 15 KW 120 V. DC Gen. DC Waukesha Eng.
4—Broderick 125 HP, 325 psi, firebox boilers.
1—150 kva EM 2300 V. AC, Gen. DC Skin. S Eng.
3—150 HP Kewanee 1942 Firebox boilers. Complete.

KINSLOW POWER & EQUIP.
STRODE BLDG., TULSA, OKLA.

FOR SALE

MODERN 1000 KW Turbo-Generator

in Excellent Condition

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker, and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum, Textile, Pulp and Paper, and Sugar Refining Industries.

NEWMAN & COMPANY, INC.
739 Drexel Building Philadelphia, Pa

STEEL STORAGE TANKS

2—1000 & 2—10,000 Bbl. New Vertical
6—74,000, 55,000 & 37,500 Bbl. Vert.
8—25,000 Gal. Cap. Horizontal
50—10,000 & 3—20,000 Gal. Horizontal
6—10,000 & 12,000 & 18,000 Gal. ⅜" Shell
20—10,000 Gal. Cap. 60 lbs. Press. Test

L. M. STANHOPE, Rosemont, Penna.

50,000 lb. Integral Furnace 400 lb. B & W boiler complete with pulverized coal burners.
1500 KW 2400 volt GE Cond. turbine nozzled 150 lbs. capable changing pressure up to 400 lbs.
285 KVA 240 volt Chase Uniflow engine set.
100 KW 250 volt GE Rotary Converter with 2300 volt transformers.
200-150-100 & 50 KW Syn. M. G. Sets 2200 AC 250 DC

H. BLANE JOHNSON & ASSOCIATES
53 W. JACKSON BLVD., CHICAGO 4, ILL.

FOR SALE

Wing Turbine Blower, size 12AK-4 Required capacity—7500 CFM at 2 in. SP. Steam conditions —110/115# initial, 5# back pressure. Still in original crates.

FIELD PACKING CO.
OWENSBORO, KENTUCKY

DIESEL ENGINE FOR SALE

Fairbanks Morse Model 42 F, heavy duty, 2 Cyl. 2 Cycle, 450 RPM, 60 HP, V grooved flywheel, weight 8500 lbs. Unused, surplus. Original cost about $7000.00. Will sell for $1200.00.

HUDSON MACHINE WORKS
Builders Tow Trucks and special vehicles
1915 GREENLEAF, EVANSTON, ILL.

POWER EQUIPMENT—READY TO SHIP

A.C. MOTORS—3 PH. 60 CY.

No.	HP.	Make	Type	Speed	Volts
1 NEW	200	West.	SYN	1200	220/440
1	250	Burke	SYN	720	2300
1 vert	250	G.E.		1175	2200
1	200	G.E.	I	860	2200
1	200	G.E.	SYN	1800	2200/550
1	175	West.	MS	1200	220/440
1	150	West.	SYN	257	220/440
1	150	West.	SYN	600	220/440
1 NEW	150	El. Machy.		720	4160/2300
1	150	West.	SYN	900	2300
1	150	G.E.	I-K	1200	2200/220/440
1	150	West.	MS	1200	220/440
3	150	Louis Allis	FX	1750	220/440
4 NEW	125	West.	SYN	1200	220/440
1	125	G.E.	I-K	900	220/440
1 NEW	125	G.E.	TEFC	600	2200/440/220
1 NEW	125	Elec. Mach.		880	2300/440
1	125	Elec. Mach.	SYN	164	220/440
1	125	West.	TEFC	3600	220/440
1	112	West.	SYN	1200	220/440
1	100	Reliance	IT	495	220/440
1	100	G.E.	I	720	220/440
1	100	Al. Chal.		720	220/440
1	100	G.E.	I-K	900	220/440
1	100	G.E.	I-K	900	2200
1	100	West.	SYN	900	220/440
1	100	Cr. Wh.	SC	1100	2200/220/440
1	100	Louis Allis	OGB	1750	220/440
1 NEW	75	Al. Chal.	AR	885	220/440
1	75	Al. Chal.		580	220/440
1	75	West.	CS-877C	660	220/440
1	75	G.E.	I-K	600	220/440
1	75	G.E.	I-K	720	2200
1	75	G.E.	I	720	220/440
1	75	Louis Allis	OGB	1200	220/440
1	75	Burke		1200	220/440
1	75	Louis Allis	FAA-505Y	1150	220/440
2	75	West.	CS (TEFC)	1750	220/440
1	60	Al. Chal.		515	220/440
1	60	G.E.	I-K	600	220/440
1	60	Cr. Wh.	SC	720	220/440
8 NEW	60	West.	CS-607 (EXPLOSION PROOF — TEFC)	600	220/440
1	60	Burke		900	220/440
1	60	Triumph		1200	220/440
1	60	G.E.		1800	550
1	60	Elec. Dyn.	drip pr.	3600	4000/2300
2	50	G.E.	KT-546	720	220/440
1	50	Cr. Wh.		960	220/440
1	50	Wagner	Fynn Weichel	900	220/440
1	50	Triumph	B	850	220/440
2	50	West.	CS	900	220/440
2	50	G.E.	KT	1200	220/440
2 NEW	50	Reliance (TEFC)	B-504-S	1750	2200
3 NEW	50	G.E. (TEFC)	K-504	1750	2200
1 NEW	30	West.	CS-445 hi-torq	900	220/440

SPECIAL BARGAINS
Diesel Engine Generator Sets

10—100 kw., 120/240 v. D.C. Delco Generators dir. con. to 150 HP Model GBD-8, 5½x7, 8 cyl. Superior DIESEL Engines, elec. start with engine panels

4—100 KW same as above with 220 or 440 v. NEW A.C. Generators

1—60 kva. 120/208 v. 3 ph 60 cy. 1800 rpm., driven by Caterpillar DIESEL mt'd on trailer

2—75 kva. 220/440 v. 3 ph. 60 cy. Delco Cummins DIESEL

2—37½ kva., 220/440 v. 3 ph. 60 cy. Buda DIESEL

10—NEW 37½ kva., 220/440 v. 3 ph. 60 cy. LeRoi Gasoline

1—31.3 kva. 120/208 v. 3 ph. 60 cy. G.E. Gen. driven by LeRoi GASOLINE

11—NEW 25 kva. 120/220 v. 1 ph. 60 cy. Le Roi GASOLINE

1—12½ kva. 120/240 v. 1 ph. 60 cy. 1200 rpm., dir. con. Hercules GASOLINE

4—12½ kva. 120/240 v. 1 ph. 60 cy. dir. con. LeRoi Gasoline Engines

1—7½ kva. 120 v. 3 ph. 60 cy. Wisconsin GASOLINE

6—3 kva. 110/220 v. 1 or 3 ph. Hercules GASOLINE

SLIP RING MOTORS—3 ph. 60 cy.

No.	HP.	Make	RPM	Volts
1	800	Westg.	585	6600
1	400	G.E.	514	2200
1	250	Cr. Wh.	600	440/220
1	100	Triumph	580	550/440/220
1	75	G.E.	1200	220/440
1	60	G.E.	870	220/440
1	60	Westg.	900	220/440
1	60	Burke	1200	220/440
1	50	G.E.	870	220/440
1	50	Allis Chal.	690	220/440
2	50	Westg.	870	2200
1	50	G.E.	900	220/440
1	50/32	G.E.	800/640	220/440
1	30	Elec. Dy	1165	220/440

VARIABLE SPEED MOTORS—230 V. D.C.

No.	HP.	Make	Type	RPM
1	200	Westg.	SK-210	500/750
1	125	G.E.	CD	400/1200
1	100	Westg.	SK-190	500/1000
1	100	G.E.	CD-165	400/1200
1 NEW	60	Westg.	CD	850/1750
1	50	Westg.	SK-170	350/1050

A. C. GENERATORS—3 ph. 60 cy.

No.	KVA.	Make	RPM	Volts
1 New	250	Westg.	1200	220/440
4 New	100	West.	1200	220/440
1	100	Elec. Mach.	164	220/440
1	100	Westg.	600	220/440
1	75	Elec. Mach.	900	220/440
10 New	37½	West.	900	220/440
11 New	25	West. (single Phase)	900	120

MOTOR GENERATOR SETS—250 V.D.C.
Motors 220/440 volt or 2200 volt 3 phase, 60 cycle

No.	KW	Make	RPM
3	250	Westinghouse	1200
1	200	Westinghouse	720
2	200	Westinghouse	1200
1	100	Westinghouse	700
1	100	General Electric	900
1	100	Westinghouse	600
1	100	General Electric	1800
1	100	Reliance	880
1	100	Delco	1200
2	90	Westinghouse	680
6	75	Westinghouse	720
1	75	Westinghouse	1200
1	60	Westinghouse	1200
1 New	50	General Electric	1800
3	40	Westinghouse	900
2	30	Westinghouse	720

125 V. DC M.G. Sets

1—100 kw. G.E. 125 v. 900 rpm. 220/440 v. 3 ph. 60 cy. AC Syn.

1—75 kw. West. 125 v. 1200 rpm. 220/440 v. 3 ph. 60 cy. Syn.

TRANSFORMERS — 1 ph. 60 cy.

No.	Kva	Make	Pri.	Sec.
1	500	Standard	2300	575/460/345 230/115
3	500	G.E.	2300	220/440
6	333	Mahoney	2300	230/460
3	200	G.E.	2300/4000	230/460
3	150	West.	2400/4160	240/480
3	150	Pgh.	2200	230/460
1	100	Peerless	2300	230/460

BRAND NEW TURBO SET

Westinghouse Steam Turbine consisting of 200 kw., 220/440 v., 3 ph. 60 cy. 1200 rpm., 80% P.F. A.C. Generator—40 kw., 120 v. 1200 rpm., D.C. Exciter and Westg. Reduction Gear.—Non-cond.

SPECIAL BARGAIN AIR COMPRESSOR

6—240 CFM Westinghouse type 3 VS-23 3 cyl. vert., 150 lbs. pres. dir. con., to 50 HP., 220/440 or 2200 v. 3 ph. 60 cy. West Slip Ring Motors, auto. control. Can furnish D.C. Motors or Oil or Gasoline Engines if desired.

WRITE, WIRE OR PHONE YOUR ELECTRIC NEEDS—SEND FOR STOCK LIST. LIST YOUR IDLE EQUIPMENT WITH US.

Duquesne Electric & Mfg. Co. Pittsburgh 6, Pa.

BOILERS

10 to 1000 H.P.

NEW-USED RECONDITIONED

Steam, Gas and Electric Power Equipment

J. PARKER THOMPSON CO., INC.
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MURRAY HILL 7-6547-8-9

- MOTORS, M-G SETS
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- TRANSFORMERS
- FREQ. CHANGERS
- CONTROL EQUIPMENT

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DIESEL GENERATOR PLANTS

COMPLETE WITH SWITCHBOARDS

1000 KW to 100 KW

STATIONARY and PORTABLE

AT GREATLY REDUCED PRICES

NEW UNIT GUARANTEE

HERCULES ELECTRIC MACHINERY and EQUIPMENT CO.

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OIL COOLED
AIR COOLED
PHASE CHANGERS

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1932 E. Westmoreland St., Philadelphia 34, Pa.
GArfield 5-0433

USED TRANSFORMERS
REWOUND
REBUILT
RECONDITIONED

MOTORS • GENERATORS • TRANSFORMERS

MOTORS
3 PHASE—25 CYCLE—220/440 VOLTS

H.P.	Make	Type	Frame	RPM
150	Gen. Elect.	IK-17		365
150	Gen. Elect.	IK-16		480
150	Gen. Elect.	1M-16	Slip Ring	480
150	Allis Chalmers			1450
150	Gen. Elect.	KT	557	1455
200	Westinghouse	CS	2200 volt	1500
350	Westinghouse	CW	Slip Ring	500
500	Gen. Elect.	IK		485
600	Gen. Elect.	MT	Slip Ring	490
600	Westinghouse	CS		490

HIGH FREQUENCY M-G SET

250 KW G.E. single phase 400v., 960 cy., 3600 RPM, direct connected to 375 HP G.E. induction motor 3 ph., 60 cy., 440 v. Complete with motor starting equipment, generator and exciter panel.

350 KW GENERATORS

2—350 KW G.E. generators type MPC, 250 v. D.C. 720 RPM single bearing machines.

DIRECT CURRENT EQUIPMENT

125 or 250 v. motors and motor generator sets in all sizes.

6250 KVA TURBO-GENERATOR

1—6250 KVA Gen. Elect. Unit—Generator 3 Phase, 60 cycle 2300/4160 Volts 3600 RPM. Complete Installation For Immediate Delivery.

200 HP SYNCHRONOUS MOTOR

200 HP Gen. Elect. Synch. Motor—New 2/60/2300/225 RPM—1.0 PF Engine type with M-G set for excitation and 200 HP Gen. Elec. New Full Voltage Sys. Dead Front Control Panel.

700 KW M.G. SET

2—350 KW Gen. Elect. Type MPC 250 volt, 720 RPM Generators will direct connect to 1000 HP Synchronous Motor or will sell Generators separately.

200 KW M.G. SET

200 KW Westinghouse NEMA Frame Generator 250 Volt DC, 1200 RPM, direct connected to 300 HP Westinghouse Synchronous motor 3/60/208/1200 RPM, A.C.—D.C. Panels—Like New

Immediate Shipment.

SLIP RING MOTORS
3 Phase—60 Cycle—220/440 Volts

H.P.	Make	Type-Frame	Speed	Remarks
3— 20	LA1	KH	900	
20	G.E.	MT-303	1800	
20	Cr. Wh.		1800	
3— 25	West.	CW	585	
25	G.E.	MT-343	690	
25	West.	MW	690	
40	West.	CW-749A	690	
6— 40	G.E.	MT-326	1200	
40	G.E.	MT-523	1800	
50	G.E.	MT-536	1200	
50	G.E.	MT-537	1800	
3— 50	West.	CW	1800	
60	G.E.	MT-533	1800	
60	West.	CW-853C	1800	
100	West.	CW	435	3 bearing
3—100	G.E.	I form M	900	
2—100	G.E.	MT-347	1800	
125	G.E.	I form M	1200	
3—250	G.E.	I form M-16	900	
350	West.	CW	435	2200 volts
500	Al. Ch.	ANY-WR	514	2200 volts
600	G.E.	MT	490	25 cycle

This motor will rewind satisfactorily to 700 G.E. MT 720

HORIZONTAL & DUPLEX
Compressor & Vacuum Pumps after Coolers, Filters

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3—25 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—25 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—37½ KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—37½ KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—50 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
6—50 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
4—75 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—100 KVA Niagara O.I.S.C. 2400/120/240, 1 Phase, 60 cycle, with taps.
5—100 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
6—150 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.
3—167 KVA Niagara O.I.S.C. 2400/100/240, 1 Phase, 60 cycle, with taps.
2—250 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase 60 cycle, with taps.
3—333 KVA Niagara O.I.S.C. 2400/240/480, 1 Phase, 60 cycle, with taps.

TRANSFORMERS

3—100 KVA Gen. Elect. Transformers. Type H Form KF—2400/4160 volts primary 120/240 volts secondary. Price $450.00 each. Electrically O.K. F.O.B. truck, Minnesota.
2—50 KVA Gen. Elec. Transformers. Type H Form K—1 Phase 60 Cycle 2300 Volts Primary 115/230 Serial No. 3154838.
3—200 KVA Westinghouse Transformers. Type SK—1 Phase 25 Cycle 2300 Volts Primary 115/230 Volt. Secondary. Serial No. 1214680-90-91.
3—100 KVA Kuhlman OISC 60 cy., 1 phase, 11,000v. primary, 240/480v. secondary.
1— 50 KVA Kuhlman OISC 60 cy., 1 phase, 11,000v. primary, 120/240v. secondary.

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All Sizes In Stock. 60 cycle to 90 cycle, 100 cycle, 120 cycle, 180 cycle and any other high cycle.

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1—140,000# New Steam Generator 600#, also Super
2—90,000# Boilers, 625#, 825' F.H., Economizer and Air-heater
2—60,000# B&W 450# superheat
3—30,000# B&W 450# superheat
5—1000 HP Vogt 300# with Super
3— 750 HP Stirling Type Boilers 200#
2— 600 HP B&W Sectional header 200# Boilers
1— 400 HP B&W Co. Sectional—Super 200 to 350#
4— 500 HP B&W Sectional Header 200# Boilers
2— 300 HP Straight Tube 200# Boilers
Also smaller Boilers & Fire Tube Boilers

TURBO UNITS

1—10,000 KW, Extraction type, cond. 600#
1—10,000 KW Turbo-Generator—Cond.
1— 7,500 KW Turbo-Generator—Cond.
1— 5,000 KW Turbo-Generator—Cond.
2— 3,000 KW & 2—2500 KW same as above } Also 400# & 600# & turbos
3— 2,000 KW same as above
2— 1,500 KW same as above
2— 1,250 KW same as above
2— 1,000 KW same as above
1—500 KW same—Also 750 KW & 300 KW Units
Non-Cond. :—300—500—750—1000—1500—2000

Complete Steam Plants with 2—1250 KW; 2—2500 KW; 2—3000 KW & 7500 KW
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Corliss Steam Engine & Generator—200 KW, 240 Volt, 500 RPM, General Electric, Type DM.C. Direct Current, 800 Ampere Generator, Serial #356031—belted to an Allis-Chalmers 14 x 36 R.H. 135 RPM single concentric engine — includes generator panel with circuit breaker, two pole switch, ammeter, voltmeter and rheostat. Engine has 13 foot, split flywheel—operates at 150# pressure—2 bearing machine —3 wire with balancer coils—excellent condition. Price $1000.00 loaded cars.

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MILWAUKEE 14, WIS.
Mr. W. H. PRITCHARD

Most all units still on foundation. Many may be seen operating

TURBO UNITS (Cond.)

1625 KVA Wghse. 2300 v., 150# (bleeder)
1250 KVA Elliott 2300 v., 200# (bleeder)
1250 KVA (2) Elliott 480 v., 150/200#
1250 KVA Wghse. 2300 v., 450#
1250 KVA GE 4150 v., 200#
937 KVA Elliott 2300 v., 175# (bleeder)
750 KVA GE 2300 v., 200#
625 KVA (2) GE 2300 v., 150/200#
625 KVA GE 2300 v.—Murray, 250#
375 KVA Wghse. 220/110 v., 100/125#
375 KVA Al. Chal. 480/240 v., 190#

TURBO UNITS (Non-Cond.)

937 KVA Al. Chal. 480 v., 150#
750 KVA GE 550 v., 70# BP
625 KVA GE 2300 v., 150/200#
250 KVA GE 600 v., 150/200#
62½ KVA; 112 KVA; 125 KVA; 200 KVA and 250 KVA GE 480/220 v. units

DIESEL UNITS

250 KVA (2) Buckeye 2300/480 v.
250 KVA FM 2400/480/240 v.
109 KVA GE-Superior 240/480 v.
106 KVA GE—Murphy (portable) 220/440 v.
75 KVA (2) GM, 2400 volts
75 KVA (2) GM 480/240 v.

BOILERS

680 HP BW, sec. header, 200#
625 HP Vogt bent tube 450#
600 HP (2) B&W Sec. Header, 200#
540 HP Keeler 250#
509 HP (2) BW sec. header, 200#
509 HP Sterling, 450#
490 HP (2) Erie City 3 drum, 160#
480 HP Springfield, sec. hd. 250#
438 HP (2) BW 2 drum, bent tube 200#
400 HP Erie City, Heine type, 200#
250 HP (3) Titusville fire box 125#
250 HP (2) B&W 3 drum, 160#
250 HP (2) B&W 3 drum, 200#
162 HP (2) Keeler, portable, 250#

STEAM ENGINE SETS, A.C.

500 KVA GE-Skinner Unif.
450 KVA GE-Ames Unif. Cond.
400 KVA GE-Erie Ball 4 v.
312 KVA GE-Chuse 4 v.
312 KVA GE-Ames Unif.
312 KVA (2) CW-Skinner Unif.
250 KVA GE-Ames Unif. ver.
240 KVA GE—Nordberg Unif.
187 KVA Elec. Mchy.—Ames Unif. ver.
187 KVA GE-Chuse 4 v.
187 KVA Wghse.-Ames Unif. Ver.
62½ KVA GE-Ames Unif.

PUMPS — MOTOR DRIVEN
COMPRESSORS — MOTOR DRIVEN
TRANSFORMERS
MOTOR GENERATOR SETS

POWER PLANT EQUIPMENT CO., INC.

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1—12500 KVA Al. Ch. Cond. 60 cy. 6900 V. 25G-lb. 600 deg. Surface Condenser.
1— 5000 KVA G.E. Non-C. 60 cy. 13200 V. 600-lb.
1— 3125 KVA Worthington Non-C. 60 cy. 2300 V. 150-200 lbs., 40 lbs. BP.
1— 2500 KVA G. E. Extraction Cond. 60 cy. 480 V. 185-200 lbs. steel valve chest.
1— 1563 KVA G. E. Extraction Cond. 60 cy. 480 V. 200-lbs.
1— 1250 KVA Allis Cond. 60 cy. 2300 V. 150-200 lb.
1— 125 KVA West. Non-C. 60 cy. 240/480 V. 150-lb., 5-lb. BP.
1— 25 KW Allis Non-C. DC 125 V. Exciter Dual drive turbine & motor.

ROTARIES — 60 Cy.

1—2929/3705 KW Gen. Elec. 225/285 V.
1—2160/2700 KW Gen. Elec. 240/300 V.
1—1000 KW Westinghouse 600 V.

DIESEL ENGINE UNITS

2—1600 HP Fair. Morse 60 cy. 2300 V. NEW gen.
3— 700 HP Gen. Motors 2300 V. 60 cy. Gen.
1— 600 HP Fair. Morse 2400 V. 60 cy.
1— 400 HP DeLaVergne 2400 V. 60 cy.

STEAM ENGINE UNITS

1—1125 KVA Nordberg Uniflow, 480 V.
1— 312 KVA Ames Uniflow, 240 V.
1— 250 KVA Ames Vertical Uniflow, 480 V.
2— 187 KVA Ames Vertical Uniflow, 240/480 V.

SPECIALS

3—700 HP General Motors Diesel 8 cyl. 4 cy. 360 RPM dir. con. To 485 KW .8 PF 3/60/2300 V. generators.
1—4500/6000 KVA G. E. 3/60 transformers H.V. 66000 Gr. Y, 8 minus taps to 54224 L.V. 33000, 2—5% plus taps. Automatic H.V. load ratio control.

SYNCHRONOUS MOTORS — 60 Cy.

1—600 HP G. E. 440 V. 360 RPM
2—350 HP G. E. 2300 V. 257 RPM
1—300 HP G. E. 2300 V. 600 RPM
1—300 HP West. 2300 V. 900 RPM

INDUCTION MOTORS — 60 Cy.

1—300 HP West. S/R 2200 V. 1770 RPM
1—250 HP G. E. S/R 2200 V. 1800 RPM
1—200 HP Cr. Wh. S/C 2300 V. 720 RPM. NEW.
1—200 HP G. E. S/R 2200 V. 435 RPM
1—150 HP Cr. Wh. S/C 440 V. 900 RPM. NEW.
1— 75 HP Al. Ch. S/C 440 V. 900 RPM
3— 75 HP Cr. Wh. S/C 220/440 V. 1200 RPM

MOTOR GENERATOR SETS

2—1500 KW West. 250 V. DC 60 cy.
2— 500 KW Cr. Wh. 250 V. DC 60 cy.
2— 300 KW G. E. 250 V. DC 60 cy.
1— 75 KW Star 240 V. DC 60 cy.
1— 75 KW West. 125 V. DC 60 cy.

MERCURY ARC RECTIFIERS

2—4500 KW Multi Anode 600 V. DC
2—3250 KW Ignitron 650 V. DC

FREQUENCY CHANGERS

1—2500 KVA G. E. 25/60 cy. 300 RPM
1—1250 KVA West. 25/60 cy. 300 RPM
2—1000 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA Al. Ch. 25/60 cy. 300 RPM

TRANSFORMERS — 60 Cy.

1—4500 KVA G. E. 66000—13000, 3 ph.
3—1000 KVA West. 66000—2200
1—5000 KVA West. 44300—13750, 3 ph.
3— 667 KVA G.E. 44000—2300/4000, 3 ph.
1—5000 KVA G. E. 33000—2300/4600
6— 50 KVA G. E. 33000—2300
6— 75 KVA Moloney 33000—2300/6900
3—3750 KVA West. 26400/13200—2400
4— 450 KVA Al. Ch. 25410/44600—13200/23000
1—2500 KVA G. E. 13800 Rectifier Type
3— 333 KVA G.E. 13200—2400/4160 Y
2— 750 KVA West. 13200—440
3— 200 KVA Moloney 11000—2300
3— 167 KVA G. E. 7200/12400—240/480
1—1500 KVA West. 4000—2300, 3 ph. Auto
3— 167 KVA G.E. 2400/4160 Y—480
3— 250 KVA Al. Ch. 2300—460

OIL CIRCUIT BREAKERS

1— 600 A. 73 KV G. E. FHKO-150 Outdoor
1— 400 A. 37 KV G. E. FHKO-136-CS Outdoor
1— 400 A. 37 KV Condit FO-40-B Outdoor
1—1200 A. 34.5 KV G. E. FKO-339-1000 Outdoor
4—2000 A. 23 KV G. E. FKO-339-1000 Outdoor
4— 600 A. 15 KV G. E. FHKO-138BS Outdoor

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Two 2000 GPM pumps with motors.
I-R Compressor 20,000 CF/HR at 100# pressure
Motor-driven Blower—1000 cfm at 4 lbs.
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Quality SINCE 1906 — Wente — *Motors* — WIDE SELECTION UNUSUAL VALUES

THEIR ELECTRICAL CONSTRUCTION HAS BEEN REBUILT . . . BY EXPERTS

SQUIRREL CAGE
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

Qu.	HP	Make	Type	Speed
1	50	G.E.	I (2200 V.)	900
2	50	Al. Ch.		900
1	60	G.E.	KT	1800
1	60	G.E.	KT (2200 V.)	1200
1	60	Reliance	AA	900
1	75	G.E.	KT	1250
1	200	G.E.	KT (2200 V.)	900
1	100	G.E.	K (TEFCBB)	1200
1	110	G.E.	KTP	1800
1	120	G.E.	FT	3600
2	125	Cr. Wh.	129Q	450
8	125	Al. Wh.	AR	450
2	150	Al. Ch.		1750
1	250	G.E.	I-17	900
1	250	G.E.	KP (Vert.)	3600

SLIP RING—SYNCHRONOUS
3 ph.—60 cy.—220 or 440 V.
(Other voltage as noted)

1	50	Al. Ch.		720
1	50	Ideal	AV	600
2	50	G.E.	I	720
1	60	Ideal	AVX	1200
1	75	West.	CW	400
1	75	G.E.	I	520
1	75	Fr. Morse	HY (2200 V.)	1800
1	100	G.E.	TRB (1.0 PF)	600
1	100	G.E.	I-16 (2200 V.)	450
1	100	West.	CW (SCP.)	1800
1	100	KW G.E.	ATB 1.8 PF)	900

Qu.	HP	Make	Type	Speed
1	125	Fr. Morse	T (2400 V.) (PF1.0)	900
1	150	West.	CW	450
1	200	West.	CW (1 Bear.)	600

D.C.—230 VOLT
(Other voltage as noted)

1	50	West.	SK	850
1	50	G.E.	CD 1041	500/2000
1	50	Reliance	T	2700
1	50	West.	SK (115 V.)	500
1	60	West.	SK (115 V.)	500/1500
1	75	Diehl	K11	700
1	75/100	Reliance	T7150	300/900
1	100	West.	SK	850
1	100	Cr. Wh.	CM	600
1	150	Cr. Wh.	CMC (550 V.)	600/1200
1	150	West.	SK	400/1200
1	150	West.	SK	850
1	180	Cr. Wh.	CMC	450
2	200	Reliance	T7250	300/900
2	200	G.E.	TLA5-T4	1550/4000

M-G SETS

1— 45 KW West. 60 V DC—440 V AC 1200 RPM
1— 60 KW G.E. 60 V DC—440 V AC 1200 RPM
2— 75 KW El. Prod. 220 V DC—440 V AC 1200
1—100 KW West. 250 V DC—440 V AC 1200
1—100 KW West. 250 V DC—440 V AC 900
1—100 KW Reliance 250 V DC—220 V AC 1200
1—100 KW Ridge 275 V DC—440 V AC 1200
1—150 KW G.E. 275 V DC—440 V AC 900
ALSO—4000 motors other than listed from 1 HP to 200 HP

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MOTORS—M.G. SETS—TRANSFORMERS

SQUIRREL CAGE MOTORS 3-PHASE 60-CYCLE

Qu.	H.P.	Make	Type	Volts	RPM
1	400	G.E.	1-K	2300	514
1	400	G.E.	KT-412	2200	435
1	250	Whse.	CS	2300	1160
1	200	Al. Ch.	AK	220/440	580
1	150	C.W.	1504Q	220/440	570
1	125	Whse.	CS-761C	220/440	1750
1	125	Whse.	CS-7728	2200	1170
2	125	C.W.		220/440	430
1	125	Al. Ch.	AR	220/440	435
1	100	G.E.	1K	220/440	1725
3	100	Whse.	CS-6630	220/440	1750
1	100	Al. Ch.	AR-226	2200	1160
1	100	G.E.	KT-556	2200	865
5	100	F.M.	B8	220/440	880
1	100	Al. Ch.		550	720
1	100	F.M.	B-2413	220/440	450
1	75	Whse.	CS	440	1750
1	75	Al. Ch.	AR	2200	1765
1	75	Burke	EM-10	550	720
3	50	Whse.	CS	220/440	690

SYNCHRONOUS MOTORS 3 PHASE—60 CYCLE

Qu.	HP	Make	P.F.	Volts	RPM
1	1440	Whse.	.8	2300	514
1	700	G.E.	.8	2300/440	720
1	400	Whse.	.8	440	600
1	268	Al. Ch.	1.0	2200	900
1	150	Whse.	1.0	2200	400
1	125	G.E.	.8	2200	900
3	100	Whse.	.8	440	1800
1	100	Whse.	1.0	2200	1200
1	100	Ideal	.8	440/220	900
2	100	G.E.	.8	440/220	900
1	60	G.E.	.8	440/220	1200
2	50	G.E.	.8	2200	600

SLIP RING MOTORS CONSTANT DUTY 3-PHASE 60-CYCLE

Qu.	HP	Make	Type	Volts	RPM
1**	2000	G.E.	MT	2300	240
1**	1500	Al. Ch.	ANY	2200	238
2**	1000	Al. Ch.	ANY	2200	235
1**	800	G.E.	MT-15	2200/6600	600
1**	600	G.E.	MT-412	2200	720
1	500	G.E.	IM	2200/4400	900
1	500	Whse.	CW	2300	575
1	500	Whse.	CW	440	600
1	400	G.E.	IM	2200	875
1**	400	G.E.	IM	2300	500
1**	400	Al. Ch.	ANY	2200	505
1	300	G.E.	IM	2200	1200
1	300	Al. Ch.	ANY	2200	507
1	250	Whse.	CW	2300	580
2	200	Whse.	CW	440	600
1	200	Al. Ch.	ANY	2200	585
1	200	Whse.	CW	550	514
1	150	G.E.	IM	440	495
1	125	Whse.	CW	2300	870
1	125	Al. Ch.	ANY	220/440	900
1	75	G.E.	IM	220/440	695
1	50	G.E.	MT-526	2200	1150
1	40	Al. Ch.	ANY	2200/440	435

**—Mill type pedestal bearing design.

TRANSFORMERS—OIL COOLED

Qu.	K.V.A.	Make	Type	Phase	Voltage
2	4500	G.E.	HT	3	27000/13500/2300
2	1000	Pitts.	OISC	1	22000/11000/1100/2200
4	500	G.E.	H	1	13200/11880/220/440
3	333	G.E.	H	1	6900/11950Y/230/460
3	333	G.E.	H	1	2300/460/230
1	200	Pitts.	OISC	1	13800/14400/220/440
3	130	G.E.	H	1	19000/9500/550/2200
3	100	Whse.	88	1	12075/10925/460/230
6	100	G.E.	H	1	4160/7200Y/120/240
3	75	G.E.	KF	1	2400/4160Y/120/240
3	50	Al. Ch.	OISC	1	22000/220
2	50	Wag.	HE	1	13200/11880/575/287

MOTOR GENERATOR SETS

Qu.	KW	Make	RPM	Volts DC	Volts AC
2	1500	G.E.	600	600	4160/2400
1	1000	Whse.	514	600	4160/2400
1	1000	Whse.	514	600	2200
1	750	Whse.	514	275/300	2200
1	600	Al. Ch.	900	250	2300
2	500	G.E.	1200	600	550
1	500	G.E.	1200	600	2300
1	400	G.E.	1200	275/300	2300
1	300	Whse.	1200	120/240	2300/440
1	300	G.E.	720	125/250	2300/440
2	150	C.W.	900	250	2300/440
1	100	C.W.	900	250	2300/440
1	85	C.W.	1200	250	440
1	75	Whse.	1200	125	440/220
1	75	Al. Ch.	900	250	2300
1	75	Whse.	1200	250	2300/440
1	75	Star	1200	240	220/440
1 (spl)	50	Whse.	1200	120/240	440/220
1	35	G.E.	1800	125	440/220
1	30	Reliance	1800	250	440/220
1	25	Whse.	1200	120/240	440/220
1	15	Al. Ch.	1200	250	440/220
1	9	G.E.	1800	250	440/220

1—Reliance variable voltage set (2) 20-KW, 250-VDC Gen. with (1) 5-KW exciter and (1) 75-HP motor 440/220.

DIRECT CURRENT MOTORS 230 VOLT

Qu.	HP	Make	Type	RPM
1***	2500	G.E.	MCF-14	200/400
4***	1500	Whse.	Excl.	600
1***	1250	Whse.	Mill	300/600
1	500	G.E.	MPC	160/330
1	400	Al. Ch.	Mill	400/1200
1***	350	G.E.	MCF-4	200/600
1	225	Whse.	QM	450/900
1	200	El. Dy.	22	400/1200
1	200	Whse.	8K	300/1200
1	150	G.E.	MPC	262/525
2	125/150	Rel.	2550T	300/900
2*	150	C.W.	83H	890
2	100	Rel.	1050T	400/1200
1*	50/75	Rel.	1001P	300/1200
1*	40/60	G.E.	CD-173A	400/1200
1	50	Whse.	8K	300/1200
1*	30/75	Whse.	8K-151L	400/1200
1	35	Whse.	8K-140	500/1500
1	25	Whse.	8K-111L	250/1000

***—600-VDC mill type. *—T.E.F.C.

T. B. MAC CABE COMPANY.

4314 CLARISSA STREET PHILADELPHIA, PENNA.

POWER PLANT EQUIPMENT

3—40,000 lbs. per hour B. & W. Type "E"
Boilers, 450 psi; complete plant.

QUICK DELIVERY

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AIR COMPRESSORS FOR SALE

9 x 9—Chicago Pneumatic Horizontal Type "TB"—Timken Roller Bearings V-Belt-Force Feed Lubricator—Unloading Valves 40 H.P. Motor—3-60-220 Volts-1750 rpm—Starter

7 x 7—Chicago Pneumatic Horizontal type "TB"—Timken Roller Bearing—V Belt—Force Feed Lubricator—Unloading Valves 20 H.P. Motor—3-60-220 Volts—1750 rpm—Starter.

Above machines like new. In operation approx 1½ years

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TRANSFORMERS FOR SALE

2— 150 KVA. 60 CY. 1 PH. 2400-240/480 SCOTT TAPS.
6— 100 KVA. 60 CY. 1 PH. 2400-240/120.
6— 75 KVA. 60 CY. 1 PH. 2400-240/120.
9— 50 KVA. 60 CY. 1 PH. 2400-240/120.
7—37½ KVA. 60 CY. 1 PH. 2400-240/120.
8— 15 KVA. 60 CY. 1 PH. 2400-480/240.

ALSO ALL TYPES OF AIR COOLED AND PHASE CHANGERS.

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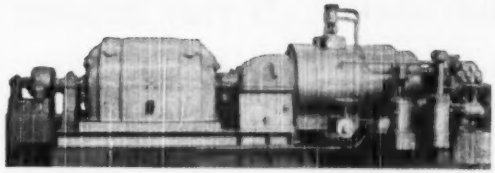

2500 KVA ALLIS CHALMERS CONDENSING TURBO UNIT

2000 KW 80% P.F. 2500 KVA Allis Chalmers Generator, 3 phase 60 cycle 4160/2300/600/480 volts, direct connected to 2000 KW Allis Chalmers condensing turbine, 250-400# steam pressure, 650° TT, 3600 RPM.

Equipped with direct connected exciter, surface condenser and auxiliaries.

This unit is designed for high efficiency. The full load steam consumption is approximately 11# steam per KW hour.

New 1933—Excellent Condition.

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3 phase 60 cycle

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5000 KVA G.E. 600# steam, 150# extraction, 50# exhaust, 13,800/6900/4000 volts.
3750 KVA Allis 250# steam, 2" exhaust, 480 volts.
1563 KVA G.E. 250# steam, 20# exhaust, 2400 volts.
937 KVA G.E. 200# steam, 25# extraction, 2" exhaust, 480 volts.

UNIFLOW UNITS — *3 phase 60 cycle*

750 KVA Skinner Vertical, 150# steam, 5# exhaust, 4000/2300/480 volts.
625 KVA Skinner, 150# steam, 5# exhaust, 240/480 volts.
375 KVA Skinner 150# steam, 5# exhaust, 2300/480 volts.
250 KVA Skinner 150# steam, 5# exhaust, 240/480 volts.

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ATTRACTIVELY PRICED

2—G. M. Model 6-71RC, 1200 RPM, 6 cyls., direct connected to 75 KVA Generators 3/60/127/220/440. Complete. New 1946. Only used 100 hours. Guaranteed condition.

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BLOWERS

From 1000 to 80,000 CFM.

MOTORS

3—125 HP, 440V., 1750 RPM, TEFC.
2— 50 HP, 440V., 1170 RPM, TEFC.
(OTHER NEW TEFC & X.P. MOTORS to 7½ H.P.)

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1—26"x11' & 22"x9' Lathes—Good Cond.
1—150-200-500-700 HP Motors—Others

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With all accessories — underfeed, single retort, side dumping.

Width between side walls 6 ft. 6 in. Length from inside front wall to face of bridgewall 6 ft. 4½ in. Equipped with Riley-Jones Riflex Mechanical drive consisting of a highly efficient spur gear reduction unit operating a ram with a simple timing mechanism to vary the interval between ram strokes, thus giving a quick full stroke of the ram at all rates of feed. Stokers are of the unit type driven from fan motor through silent chain drive. This was stand-by equipment and is in excellent condition and available for inspection at warehouse in Bayonne.

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GENERATOR UNIT, consisting of GE AC generator Type 8TB, 450 Amp., 240 Volt, and 1—GE Type ER, DC generator, 40 Amps., 125 Volt. Above belt driven by one 18"x20" Fitchburg 300 HP steam engine.

All three units in good condition

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SLIP RING MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Speed
450	440/220	Whse.	514
250	2300/440	Whse.	600
200	440/220	Whse.	514
200	440/220	Whse.	900
200	2300/440	G.E.	1200
200	440	G.E.	450
150	440/220	Whse.	600
150	440/220	Whse. (2)	1200
150	2200/440	G.E.	1200
150	440/220	G.E.	720
100	440/220	G.E.	600
100 (2)	440/220	Whse.	900
100	2200/550	G.E.	1800
80	440/220	G.E. (MTC)	900
75	2300/550	G.E.	1800
75	440/220	Whse. 25 cy.	750

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

HP	Volts	Make	Type	RPM
600	2300/440	G.E.	T.S.	1200
400	440/220	G.E.	ATI	600
300	2200/440	G.E.	TS	720
300	440/220	G.E.	ATI	600
250	440/220	Whse.	HR	277
250	440/220	G.E.	ATI	600
240	440/220	Whse.	G	1800
200	440/220	G.E.	TS	720
200	4150/2300	Whse.	G	1800
120	440/220	G.E.	ATI	900
110	440/220	G.E.	TS	257
100	440/220	Whse.	G	1800
75	2200/440	Whse.	GE	600

GENERATOR SETS

1—62½ kva. 1200 rpm, 220 volt, Whse., geared to 1300 rpm, Whse., non-cond. steam turbine, 150 lbs. pr.
2—mated 25 kva., 120/208 v., 3 ph., 1200 rpm, generator dir conn. to Waukesha 6 cyl. gas engine

AIR COMPRESSOR UNIT

1—13" and 9" by 10" Worthington FEATHER-VALVE, 285 rpm, 110 lbs. ga. motor-driven.

CIRCUIT BREAKERS

2—2000 amp., GG E, 3 pole, 600 v., air
3—1600 amp., ITE, 3 pole, 600 v., air
3—1200 ampere, Whse., 3 pole, 600 v., air

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	900
350	2300	G.E.	KT	1200
300	2200/550	Whse.	CS	1800
250	440	G.E.	KT	900
250	2200/440	L. Allis	OGS	1200
200	440	G.E.	IK	514
200	440/220	Whse.	CS	1200
200	440/220	G.E.	KT	1800
200	2200/440	G.E.	KF	720
200	2300/550	Cr. Wh.	SC	900
200	2200/440	G.E.	KT	1200
200	440/220	G.E.	IK	450
150	440/220	G.E.	IK	450
100	2200/550	Whse.	CS	900
150	440/220	G.E.	KT	720
150	440/220	Howell	B. Brg.	1800
150 vert.	440/220	G.E.	KTF	1200
150	440/220	G.E.	IK	514
125	440/220 (2)	G.E.	IK	514
125 vert.	440/220	G.E.	KTF	1200
100	550	Cr. Wh.	Q	900
100	2200/440	G.E.	K	1200

A. C. GENERATORS

1—320 kva. 660 rpm, 2300/440/220 V., G.E.
1—250 kva. 720 rpm, 2300/440 v., G.E.
1—250 kva. 600 rpm, 2200/440 v., G.E.
1—225 kva. 600 rpm, 220/440 v., G.E.
1—210 kva, 1800 rpm, 440/220 V., Whse.
1—100 kva, 1200 rpm, 440/220 V., Whse.

D. C. MOTORS

HP	Volts	Make	Type	Speed
350	230 (2)	G.E.	CD	1150
250	230 (2 new)	Cr. Wh.	CMC	1800
200	230	Cr. Wh.	CMC	800
150	230 (new)	Cr. Wh.	TEFC	900
100	230	Cr. Wh.	CMC	625
100	230	G.E.	CD	1750
75	230	G.E.	CD	1150
75	230	Whse.	SK	850

MOTOR GENERATOR SETS

1—500 kw, 1200 rpm, 250 v., G.E., connected to 500 hp, 1200 rpm, 2200/440 v., synchronous
1—165 kw, 1200 rpm, 240 v., G.E., conn. to 250 hp, 1200 rpm, 440/220 v., squirrel cage
1—125 kw, 1200 rpm, 250/120 v., G.E., conn. to 175 hp, 1200 rpm, 4000/2300/440 v., synchronous
1—100 kw, 250 v., Hertner, 1200 rpm, connected to 150 hp, 2200/440 v., synchronous
1—90 kw, 1200 rpm, 250 V., G.E., connected to 135 hp 2200/440 V. squirrel cage motor
1—75 kw, 125 v., 1200 rpm, G.E. conn. to 120 hp, 2200/440 v., syn. motor

TRANSFORMERS 60 Cy.

3—667 kva. Whse., 33,000—2300 V.
3—400 kva. G. E., 13,800/6900—230/460 V.
3—333 kva. Whse., 4800/2400—240/480 V.
3—250 kva. G. E., 6900/13,800—230/460 V.
4—200 kva. Whse., 13,200—2300 V. (Inertsen)
2—200 kva. G. E., 2400—240/480 V.
3—150 kva. G.E., 2400—240/480 V.
6—150 kva. Al. Chal., 2400—240/120 v.
1—150 kva. Whse. SK, 13200-125/215 v., 3 ph
3—100 kva. G. E., 4600/2300—230/460 V.
3—100 kva. G.E., 13800—230/115 v., NKW
6—100 kva. G.E., 4600/2300-230/115., NEW
2—100 kva. G.E., 450-115/230 v., dry, 1 ph, new
2—75 kva. G.E., 480—240/120 v., Pyranol
3—50 kva. G.E., 480—240/120 V., Pyr.

LOW VOLTAGE M. G. SETS

1—2000/1000 amp; 6/12 volts
Hanson Van Winkle
Munning—AC Motor driven

1—2500/1250 amp; 6/12 volts, Elec. Prod. Co. AC Motor driven

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1— 410 HP Heine Box header
2— 400 HP B&W Sectional header
2— 500 HP B&W Sectional header
2— 500 HP B&W Springfield
1—1400 HP B&W Sectional header
3—10,000 Red Flash heating boilers
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3176 Ft. SULLIVAN WN4 ELECTRIC. 125 LB.
1578 Ft. CHGO. PNEU. DIESEL. 125 LB.
1302 Ft. INGERSOLL RAND PRE-2 ELECTRIC. 100 LB.
610 Ft. WORTHINGTON V BELT DRIVE. 125 LB.
DARIEN, 60 E. 42nd St., New York 17, N.Y.

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3—Pittsburgh Transformers
Serial Nos. 693973, 693974, 691975
Specifications 4929A, single phase, 1000 KVA 60 cycle—50°, 1375 ga. of oil, Volts H. T. 11000 to 22000, Volts L. T. 1100 to 2200. Case corrugated steel frame. Top and bottom cast iron.
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80 horsepower gas and/or oil fired STEAM GENERATOR. Give full particulars.

The Pittsburgh Bbl. & Drum Co.
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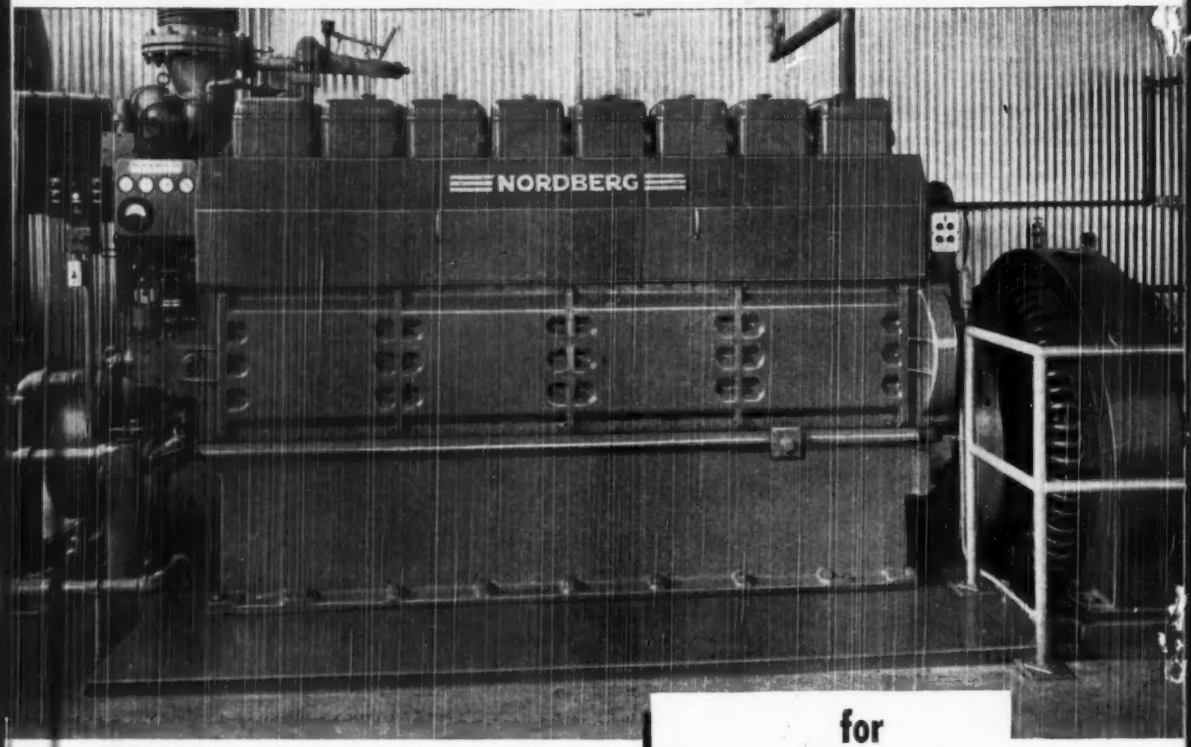

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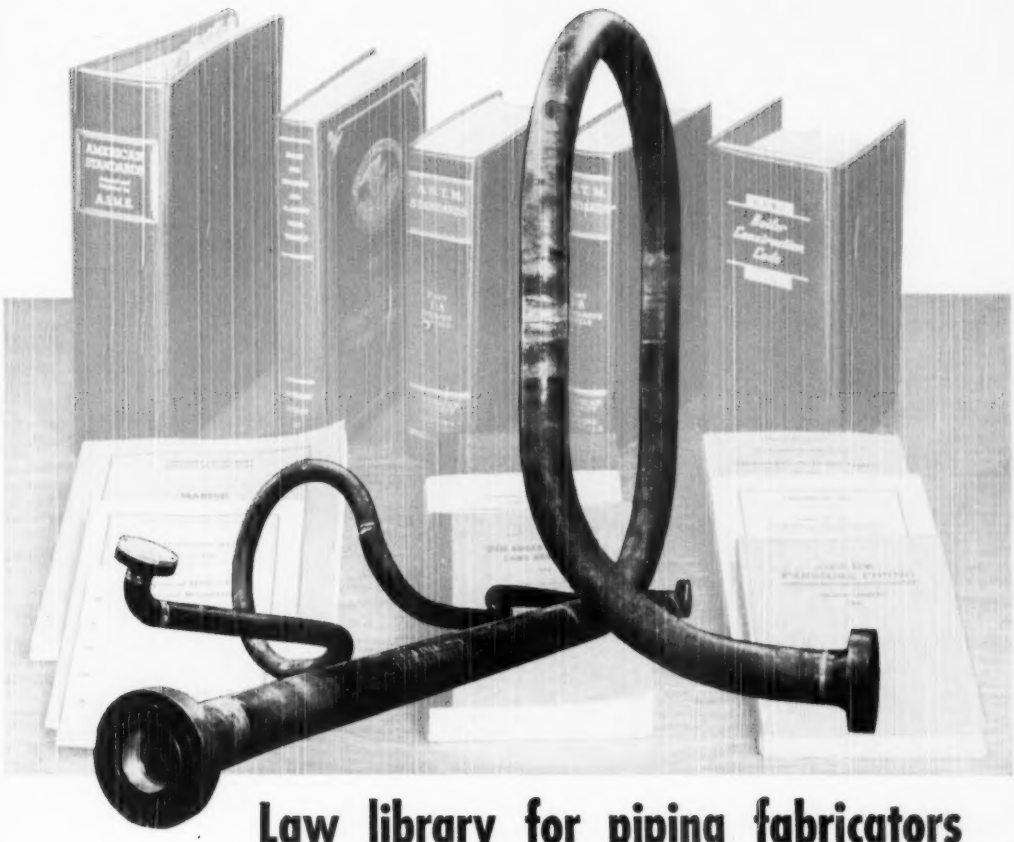

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